Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, Railway Master Mechanic, and Boiler Maker and Plate Fabricator. Name Registered, U. S. Patent Office

OCTOBER, 1937

Volume 111 *No. 10*

Editorials:

International Railway General Foremen's Association:

Car Department Officers' Association:

Railway Fuel and Traveling Engineers' Association:

Master Boiler Makers' Association:

Published on the second day of each month

Simmons-Boardman Publishing Corporation

1309 Noble street, Philadelphia, Pa. Editorial and Executive Offices: 30 Church street, New York, and 105 West Adams street, Chicago. Branch offices: Terminal Tower, Cleveland; 1081 National Press bldg., Washington, D. C.; 1038 Henry bldg., Seattle, Wash.; Room 1001, 485 California street, San Francisco, Calif.; Union Bank bldg., Los Angeles, Calif.

Subscriptions, including the Daily editions of the Railway Age, published in June in connection with the convention of the Association of American Railroads, Mechanical Division, payable in advance and postage free. United States, U. S. possessions and Canada: 1 year, $3; 2 years, $5. Foreign countries, not including daily editions of the Railway Age: 1 year, $4; 2 years, $7. Single copies, 35 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.


Machine Flame Cutting
anywhere in the shop
with the OXWELD* CM-16
CUT WITH THE CM-16
IN THE BOILER SHOP—Shell Sheets... Smoke-Box Sheets... Door Sheets... Back and Front Flue Sheets... Piled Plate... Liners... Patches.
IN THE CAR SHOP—Piled plate consisting of—Hopper Sheets... Center Ridge Sheets... Cross Ridge Sheets... Bolster Sheets... Floor Sheets... Door Sheets.
At speeds from 4 to 30 inches per minute

EDITORIALS

The Future of the Mechanical Associations

After years of suspension of activities and uncertainty as to their future, four associations of railway mechanical supervisors held conventions at the Hotel Sherman, Chicago, during the week ended October 2. All were successful judged by the character of the programs and the extent of the attendance. Their success was greatly enhanced by the extensive exhibit of locomotive, car and shop appliances to which approximately 1,000 railroad men gave close attention before and after the sessions of their conventions. The comments of exhibitors indicated unqualified satisfaction with the results from their standpoint. At the same time those registered at the various conventions were faithful in their attendance at all of the sessions. Concern was evident among members of some of these associations as to the attitude of the railway officers, or, more accurately, the attitude of the A.A.R., with respect to their future activities. There is no doubt but that this concern was justified by the unfavorable opinions expressed by a few railway executives. The work of these associations will no doubt always be opposed by some officers who are blind to the dormant powers hidden in the human material of which their organizations are built. These powers are seldom more than partially developed, unless released by inspiration and encouragement. Inspiration and encouragement grow out of mutual respect. What better evidence of mutual respect of the management for their supervisors can be shown than to encourage them to join with others of their kind, free from official domination or censorship, in the consideration of ways to improve the effectiveness of their work?

The cost of conventions such as those held at Chicago is a cheap price to pay for the results in education, in suggestions for new ways of exercising ingenuity, in inspiration which sends men back with renewed courage to surmount the never-ending obstacles with which their jobs are surrounded. It is true that the returns are not of the kind which can be computed in immediate terms of dollars and cents and turned in with the expense account at the end of the meeting. The account must be held in suspense until the next meeting and then it can only be appraised correctly by those officers who possess the insight to trace improvements in the functioning of their organizations and increases in the efficiency of their operations to ultimate causes. Those unfortunate officers whose thinking is limited to the mechanical processes of the adding machine, who are blind to those subtle qualities of human nature which distinguish men from machines, will never be able to evaluate such intangible values.

It may be admitted that there have been times when officers with the insight to appraise correctly the value of associations have had difficulty in finding a return which would justify the expenses entailed in sending some of their men to some of the meetings. The future of these associations is in the keeping of their officers and executive committees. The seriousness of purpose prevailing at this year's meetings was such that their future prospects are favorable. If they continue to improve on the more or less hastily developed programs which some of them had to depend upon this year, the question of their future will soon cease to be a matter of concern to their members or to the railway officers to whom their members report.

Car Department Association Makes a Good Start

The Car Department Officers' Association suffered the loss of as much morale as any of the associations, the activities of which were curtailed during the depression. Meetings were completely suspended and no effort was made to hold the members together after 1930 until this year. It was, perhaps, as much of a surprise to its officers as to anyone else that the registered attendance at the meeting during the last week in September was over 250. Such an attendance, no doubt, implies effective work on the part of the officers in preparing for the meetings. But it must also be taken as an indication of the vitality of the association idea among the large group of car department supervisors from which it draws its members.

The program of this meeting was not typical of the kind of work which this organization may be expected to do, now that it has reorganized and is ready for regular work. While the addresses and papers all held the close attention of attendants at the meeting and, together with the discussions of the loading rules and interchange rules, touched upon a fair cross-section of the interests of the members, there were no committee reports. These will, no doubt, be among the most valuable parts of future programs in serving the needs of the members.

The purpose of the organization, as it was well stated by President Nystrom in his address, is to create friendship and better understanding among member roads, to improve and simplify interchange in complete co-ordination with the Association of American Railroads, to

study for better and more economical maintenance of passenger-train and freight-train cars in daily operation, and to improve shop practices for repairing cars and building new equipment. These are all objectives which can be effectively advanced by a voluntary organization of men, whose leaders are so much interested in the welfare of the railroads that they are willing to give generously of their own time and thought in preparation for its meetings.

The evident anxiety of the members to make their association an instrument whereby they may co-operate with the A.A.R., presents that body with an asset which it can ill afford to neglect. On the other hand, it is to be hoped that wise councils will prevail in the latter organization, to the end that the Car Department Officers' Association may be left free to work out its own destiny, guided by occasional friendly advice, no doubt, but never forced into reluctant conformity with a program "handed down from the top shelf." Thus a highly practical contribution, of which the ranks of car department supervision are capable, will be made to the advancement of transportation efficiency.

Fuel Association Meeting

The Railway Fuel and Traveling Engineers' Association convention was notable for a number of reasons. In the first place, the total registration of 494 railroad members and guests brought to the convention the largest group of railway fuel supervisors and traveling engineers which has been assembled for the discussion of mutual problems since 1930. Railroad men from the Atlantic Coast to the Pacific and from Canada to Mexico were in attendance.

From the point of view of a well-rounded program, also, the convention this year probably surpassed any previously held. With five speakers of national reputation in the railway field, the members of the association listened to addresses which were at once inspiring and designed to give a broad picture of ways and means by which fuel supervisors and traveling engineers can help the railroads, these efforts covering the entire range from necessary public relations activities to fuel conservation efforts, closer supervision of locomotive operation and improved brake handling.

Eleven technical reports were presented and discussed in detail covering practically all important phases of work done by the members of this association. On the subject of Fuel Records and Statistics, for example, the intensely practical position was taken that no railroad can be operated efficiently without a certain amount of such records made promptly available, but that on the other hand, the compilation of statistics in excessive detail, at great cost, and issued too late for effective use, serves no good purpose.

The previous excellent practice of the association in presenting committee reports and addresses on the same general subjects in a single day was followed again this year. For example, the general opening session on Tuesday, September 28, was followed by Mechanical Day on Wednesday, September 29, on which reports were presented on New Locomotive Economy Devices, Steam Turbine Locomotives, Front Ends, Grates and Ash Pans, Valve Motion and Its Effect on Fuel Economy and Utilization of Locomotives. Similarly, Thursday, September 30, was Air Brake Day and Friday, October 1, Fuel Day, with appropriate addresses and committee reports presented on each. By this method, railroad men interested in a particular subject and with a limited time available away from their regular work, were enabled to attend the convention on the day or days when subjects would be presented in which they were most interested.

All of the sessions of the association were terminated early in the afternoon of each day so that the members would have ample time to visit and study the extensive and instructive exhibits of railway mechanical equipment and supplies presented under the auspices of the Allied Railway Supply Association. An unusually effective spirit of co-operation prevailed between the two groups of railroad and supply men. Railroad men who came to this convention, and to the other three as well, attended strictly to the business of increasing their knowledge of railway mechanical equipment, materials and operating methods designed for the roads' benefit.

The Exhibit At Chicago

Both the railway men and the exhibitors were enthusiastic over the exhibit which was staged under the direction of the Allied Railway Supply Association at the mechanical conventions in Chicago. Because of the late date at which it was decided to hold these joint meetings, the railway supply association was under a considerable handicap in arranging for the exhibit. In spite of this, however, all of the available space in the exhibit hall and on the mezzanine floor of the hotel was taken, and a most comprehensive and instructive exhibit was made.

The railway representatives were especially pleased with the fact that the exhibit room was darkened and that activities among the exhibits were discontinued while the railroad conventions were in session. The railway supply group, on the other hand, were very much delighted at the thorough way in which the railway men inquired about and studied the exhibits, which while occupying only about 14,000 square feet of floor space, were specially designed to be as instructive and educational as possible.

One gage of the success of the exhibit was indicated by the fact that several railway supply concerns which did not exhibit are already planning to do so next year. This may bring some embarrassment upon the officers in charge of the various associations, since it may in-

volve holding the convention at a place which can provide more commodious exhibit quarters. This, however, may be necessitated also by the fact that the associations will undoubtedly have a much larger attendance at the next meeting and it is also quite possible that more than four of the mechanical associations will meet at the same time.

A Glimpse of The Ultimate Goal

The 1937 meeting of the General Foremen's Association has passed into history and has left its mark. If there is any one thing that stands out in the minds of those who had a part in its preparation and who attended the meeting in Chicago it is the fact that united effort, faith in the value of the association and its work, and determined personal support resulted in bringing about a meeting far beyond the expectations of anyone. No one should be misled by the fact that the registration of 92 railroad members was only slightly more than 50 per cent of the similar classification in 1930.

The intervening seven years have brought about significant changes in railroading—both in the nature of work, in personnel and in the problems to be faced. The effects of these changes were clearly visible at the Chicago meeting. The papers and the discussions indicated that the technical details of the work of the mechanical department have changed materially with the development of new ideas in the field of transportation; a glance at the roster of those in attendance indicates that the intervening years have brought into the ranks of the supervisors within the scope of the association many new faces and, most important of all, there is today a recognition of the plain fact that the immediate future is going to impose upon the supervisor the responsibility of dealing with many problems which will require him to adopt an entirely new approach to his job.

Before the Chicago meeting there was a feeling on the part of many members of the association that it was on trial and that it would have to do an outstanding job in order to justify its future existence. The trial has been held and while the final verdict has not been rendered there should not be an individual who does not now know that the effort has been worth while and that the association, as a vital force in the mechanical department, has re-established itself and should now move on into a wider sphere of usefulness.

Under the former set-up this organization embraced the general supervisors in both the locomotive and the car departments. The Chicago meeting of this and the car department group should raise in the minds of those who are to govern the affairs of the General Foremen's Association the question of the desirability of building the future of the organization around the activities of the locomotive department—both back shop and enginehouse—and to broaden the scope of its work to include and be of interest to all supervisors of general rank who are charged with the responsibility of the maintenance of locomotives.

It is only necessary causually to explore this single field to discover that it holds untold opportunities for constructive and highly valuable work on the part of such an organization as this. It has been pointed out that the railroads of this country spend more money for the repair of steam locomotives than is spent on any other single operating account. While figures are not readily available as to the total investment in shop and enginehouse facilities directly allocated to locomotive repair work, when one considers that the shops of the Class I roads are equipped with 350 million dollars worth of shop machinery alone one begins to sense that this locomotive repair industry is of sizable proportions. This vast investment in facilities and the expenditures for wages and materials represent the field in which members of this organization move about in their daily work and in which their intelligent supervision is required to maintain proper control over the cost of keeping in condition the tools of transportation.

It would serve no good purpose to point out in detail the breadth of the opportunities for constructive organization work in the field of locomotive maintenance. Let it be sufficient to say that no time should be lost in planning a real program of future activities and in deciding what may be the most worth-while objectives toward which the work of the organization should be directed. The start has been made, but it's the finish that counts.

Boiler Maker's Meeting A Real Accomplishment

The increase in membership of almost 100 per cent in the last three years to a present total of 152 and the presence of a very large part of the membership at the meeting in Chicago on September 27 and 28 was an accomplishment in itself of which the association may well be proud but the real job that was done was the fact that all through the year, in preparation for the annual meeting, a comprehensive plan was worked out by the officers of the association that resulted in a program of outstanding scope and interest.

Unlike some groups in the railroad field the members of the Master Boiler Maker's association have been entirely alive to the rapid changes that are taking place which have a vital effect on that phase of equipment design and maintenance over which they have control. The scope of these changes and the serious consideration of their significance may readily be observed in the quality and breadth of the committee reports which were presented at the two-day meeting in Chicago; the fact that the members are exceedingly well posted on what is taking place in the field was evidenced by the nature of the discussion and the foresight of the officers in printing advance copies of the papers contributed.

Excellent Attendance and Exceptional Papers at the

General Foremen's Meeting

The importance of human relations in railroading brought out by principal speakers—Car repairs, safety work and machine tools covered at sessions

A total of over 90 members attended the two-day meeting of the International Railway General Foremen's Association, held at the Hotel Sherman, Chicago, on Tuesday and Wednesday, September 28 and 29. The opening session was called to order by F. T. James, Delaware, Lackawanna & Western, president of the association.

The importance of intelligent supervision, the training and selection of men and the opportunities for supervisors to be a factor in influencing favorable public opinion for the railroads were subjects relating to the broad problem of personnel at which the principal speakers directed their remarks. The first speaker on the program at the opening session was R. E. Woodruff, vice-president, Erie Railroad, who told the members in attendance that one of the most important jobs confronting the supervisor today was that of maintaining and improving morale among mechanical department employees. H. J. Schulthess, chief of personnel, D. & R. G. W., made a strong case for a revival of systematic training of employees for the future and pointed out the need for the establishment of standards in the selection of new men that would assure the railroads of men adequately fitted for the jobs which modern railroading requires. That the railroads can not succeed without the good will of the public was the theme of an address by Roy V. Wright, editor of *Railway Mechanical Engineer,* who pointed out the opportunities which the supervisor has to build such good will.

At later sessions individual papers were presented on freight car repairs by J. E. Echols, Norfolk & Western* and J. Thompson, Delaware, Lackawanna & Western. R. C. Helwig, Delaware & Hudson, discussed the subject of accident prevention and a paper on machine tools as a factor in reducing costs was read by L. H. Scheifele, Reading Company. The morning session of the second day was devoted to an open forum on questions submitted by the members.

Election of Officers

The following officers were elected to conduct the affairs of the association for the year 1937-1938: President, F. B. Downey, assistant supt. of shops, Chesapeake & Ohio, Huntington, W. Va.; first vice-president, J. W. Oxley, general foreman, C. & N. W., Maywood, Ill.; second vice-president, Charles Kirkhuff, general foreman, A. T. & S. F., Chicago; third vice-president, J. C. Miller, general foreman, N. Y. C. & St. L., Conneaut, Ohio; fourth vice-president, J. E. Goodwin, general foreman, Mo. P., Little Rock, Ark.; secretary-treasurer, F. T. James, general foreman, D. L. & W., Kingsland, N. J. The following members were elected to the executive committee: J. B. Dunlop, general foreman, Canadian National, Stratford, Ont.; F. J. Topping, general foreman, C. & O., Huntington, W. Va.; E. W. Brown, general foreman, St. L.-S. F., Kansas City, Mo.; W. L. Rice, supt. of shops, Reading Company, Reading, Pa., and H. H. Wheeldon, general foreman, Wabash, Moberly, Mo.

How Can Mechanical Supervisors Assist Management?

Supervisors today must be leaders of men and their most important job is to build morale

By Robert E. Woodruff

Vice-President, Erie Railroad

This is a broad question and can be answered in a number of ways. Your program indicates that other speakers will touch on some of the answers. Therefore, I will limit my remarks to one phase of the question, namely, improvement of morale among shopmen.

I am sure you all realize that good morale is the foundation of good workmanship, good production and good safety records. These three are the aim of every shop.

We approach this subject from different angles.

First, we try to provide adequate facilities; a good place for men to work—well lighted, comfortable and properly heated. Whenever possible new machines are purchased—machines that will do better work in quicker time with less physical exertion.

Then we talk safety and have safety supervisors, safety committees, safety posters and safety literature, all with the idea of influencing the workers to be safe.

But with all of these things, some shops do not produce as well as others and the question is merely one of morale and the way the men in the shop react to the supervision. Men work for many things besides their pay checks. They like to be well treated; like to feel

* The paper "Modern Methods in Freight Car Work," by J. E. Echols, N. & W., which was presented at this meeting, will be published separately in a later issue.

that their work is important; and like to have security in their jobs.

The attitude of the whole shop is in general the attitude of the boss, because attitude and morale are largely governed locally. A railroad is spread out so much that the men do not come in contact with the higher officers and accordingly get their viewpoints from their immediate superiors. No amount of intelligent planning on the part of the Superintendent of Motive Power will be effective in any shop unless his policies are adequately carried out by the supervision in that shop. Therefore, good morale is a local matter. Some shops have it; others do not.

Three Kinds of Men

To be more specific, let's look at it in a different way. All railroad employees might be divided into three groups.

The first group consists of individual thinkers who are very conservative, who realize the financial and economic condition of the railroads and of the country. They do their work well, save their money, educate their children, are not much concerned in what other people do and more than likely do not belong to any labor organization.

Another group is composed of radicals. They are not interested in the railroad industry as a whole but are out for all they can get individually. They are apt to be short-sighted, not recognizing the source of their bread and butter. They will vote for the union first, the good of the membership second and feel that anything that is desired by the railroad management should necessarily be opposed by the men.

The third group, which constitutes probably over half of the total number of employees, are conservative, like their jobs, are more or less satisfied with their working conditions and wages, but are willing to go along with the crowd when occasion requires and are influenced by one group or the other. They take no prominent part in civic or union affairs but at times are dominated by the radical group. The attitude of this middle group is very important to the railroad as a whole because these men are a majority and the backbone of the industry. Their attitude is quite dependent upon the way they are treated by their supervisors. Here then is a real field for constructive work on the part of mechanical supervisors.

This middle group is either going to look at things conservatively and intelligently for the good of all or they are going to be dominated by a more or less radical leader.

It is the obligation of the management to see that all questions which affect both the men and the company are fully explained; that the facts are presented so that men can understand both sides of the questions.

Some labor organizers frequently have distorted views of current questions which often are harmful to morale and are not counteracted by the truth.

Leaders as Well as Foremen

Railroad supervisors are expected to be leaders as well as just foremen. They have access to railroad literature, to various periodicals and books that are published in which railroad affairs and economic problems are discussed. The average workman seldom sees these. If the workers are to get such information they can get it only through their immediate superiors.

Railroads should let their employees know the facts about restrictive laws, such as train limits bills and so-called full crew laws, which are not in the interest of safety nor in the interest of the employees as a whole; they are purely make-work laws that benefit a small number of railroad employees and do harm to the rest.

You all know what happens when a railroad is forced to cut expenses and what men get the cuts. Men fight for security of jobs as well as for increased rates of pay. There can be no security of jobs when the railroads are continually harassed by ill-advised laws and restrictions and increased expenses.

Mechanical supervisors, if they are leaders, can see that the facts are properly presented to the men with whom they work, remembering that there are three sides to every question, namely, what we think; what the other side thinks; and the facts. The only way to get both sides to thinking and acting harmoniously is through the medium of the facts.

Thinking men who own their own homes do not want their taxes raised as they would be if the government takes over the railroads and the railroads no longer pay taxes. In many railroad towns and outlying townships, the portion of the total taxes paid by railroads is a very substantial part of the total.

Knowing all sides of the question will enable workers to use good judgment in their meetings. A labor organization should be essentially a democracy wherein the workers determine the policy of the organization, and it will be a democracy if the workers insist upon their rights and upon having a part in the management. If, on the other hand, the policies of the organization are determined by a small group, then the men have no voice and the leaders become czars instead of servants of the organization.

To bring this about, mechanical supervisors must be leaders—leaders in thought as well as in action. Their influence extends beyond the eight-hour day and it is dependent largely on how they conduct themselves during their tour of duty. If they are good managers and good executives and have the confidence of their men, their influence will be beneficial both to men and managements.

How can supervisors be better managers? Let's analyze the situation. As a rule, mechanical officers served their time at some railroad shop and became full fledged mechanics. It is considered essential that a man should know his trade before he can become a mechanical department foreman or officer.

As a mechanic, he learned many practical things. First, he learned something about materials. He did not necessarily learn the strength of materials as engineers and chemists know them, but by dealing with them he learned to know the different properties of cast iron, wrought iron, steel, brass, etc., and found out which was the best for certain uses.

Then he learned about machines; what work could best be done on a planer, slotter, lathe, grinder or milling machine. In connection with the use of tools and machines, he learned what depth of cut to take, what feed to use and what the speed of the machine should be, realizing that too heavy a cut or too high speed would burn or break the tool. He also learned that a heavier cut can be made with high speed tools than with the ordinary kind. He learned that fillets must be of the right radius and free from scratches, as fractures develop from sharp corners or scratches. All of this knowledge is thoroughly universal and definite in its application.

As a general rule, a machine can do the same work today that it did yesterday and last week; the same kind of iron or steel can be treated today as it was treated last week or last year; and that once a method is developed it can be used again under similar circumstances. One 8-inch lathe can do the work that another 8-inch lathe can do, and in general two similar machines will turn out similar results. Nearly everything is standard-

ized as to materials and workmanship. One locomotive will pull about the same train that another locomotive of the same class will pull.

Years ago broken parts that could not be welded in the blacksmith shop were thrown away. This was particularly true of castings. A broken cylinder meant a new cylinder. But in the last few years welding has developed to the extent that many parts formerly scrapped are reclaimed by welding. Even if the material is not broken, weak parts are built up and made as strong as before. Of course, the welder learns to use the right methods, including the right kind of welding wire, finding that some wire is better for some purposes than for others. The art of welding has progressed to the point that makes it possible to save many hours and dollars in repairing locomotives.

At some time or other a vacancy occurs in the foremen's ranks and one of these craftsmen is selected for the job. In place of doing the work himself, his new job is to supervise the work of the gang. He has previously learned about tools, machinery and materials, but the chances are that he knows comparatively little about being a foreman. Some men are natural foremen and have the ability to supervise the work of others; still others have to learn how. Many good workmen make poor foremen. The question is simply one of being a good manager.

How to Be a Good Manager

How does a man go about being a good manager? First, he must analyze the job, see what it is all about and how he is going to proceed. To illustrate: A foreman was criticized by his superior officer one day for not getting out enough work in the flue shop. This foreman was of the old school who used his lungs rather than his head. He went into the shop and got his men together, bawled them out and told them they had to get more work done and speed up to avoid criticism. Immediately the men speeded up. They worked harder and hurried, and some got their fingers pinched. Production did pick up somewhat at the expense of quality. Not long afterwards this foreman was replaced with another man. His attention was called to the flue shop and his reply was, "I'll look into it." He went down to the flue shop and studied it without comment. He found the shop poorly arranged. Flues that came in from the flue rattler had to be carried to the other side of the shop where they were cut off, then carried back to the welder. He re-arranged the layout and made it easier for flues to progress from one point to another; in fact, they all but rolled from one job to the next. The production immediately stepped up. The men did not work as hard as before but more work was turned out and there were no personal injuries.

The next step is to lay out the work and plan it so that it is in proper sequence. One of the difficult things in a railroad repair shop is to keep the shop balanced; that is due to the work running heavier on one engine than another. A good shop foreman will manage the work and lay it out so that one gang will not be kept waiting for materials or keep men in another department waiting for his men to get out of the way.

There should be a general knowledge of the whole operation on the engine and the work should be so planned that all gangs will work smoothly and no one unit will be holding back the rest. It is the supervisor's job to keep ahead of his work. If he does not plan ahead his job will run him instead of his running the job.

The next move is to see who is to do the work. Traditionally, the most inefficient workman in the world is the plumber who comes to do a job in your house. He comes to see what is required, does his measuring and then has to go back to the shop to get his tools and material, while you are paying the bill. Unfortunately, the same thing frequently applies to railroad work. The men find out what they are going to do and then go to the store room or tool house to get their tools. High priced mechanics do the work of laborers or helpers.

Some years ago one general foreman used to stand in his upstairs office and look down through a window into the shop and if the men were walking reasonably fast down the aisle to and from the tool room, he felt that the operation of the shop was good. He liked to see motion. As a matter of fact, his material delivery system was not functioning. Since that time he has learned that it is better to have the tools and material delivered to every job; and now he is happy when no men are moving down the aisle for tools and material.

Activity No Index of Efficiency

The efficiency of a shop is determined by planning rather than by hustle and bustle. Any supervisor should know that a man cannot run a mile at the speed of a hundred yard dash; that the way to get more work done is not to drive men but to make it easy for them to do a day's work smoothly and without fuss and feathers.

Mechanics do not like to do laborer's work. They are perfectly content to work their full time at their own trades and they are just as proud of their accomplishments at the end of the day as the foremen are. It is the foremen's job to see that this is possible.

The next point in proper supervision is the handling of men and this is probably the most important of all. A good supervisor must be a good manager. He learns very soon that men are not like iron and steel and machines and tools; that there are no two men exactly alike; that because one man turns out ten units in a day is no reason why another man will do it without proper training, even though the same machine is used. Each man must be trained differently. Many new foremen become impatient with men through lack of experience in handling men.

As a matter of fact, there are many things he learned while serving his time that should be useful to him as a foreman. For example: A cutting tool that loses its temper is worthless and so is a foreman who loses his temper. In order to temper steel some has to be heated white hot, some only cherry red; some pieces of metal can be straightened cold, others have to be heated. So it is with men.

It is part of a foreman's job to see that his men understand the reason for the operation. If a workman understands the principles behind the work, he will go on doing the job correctly day by day without instructions. A good foreman will permit a man to use his head in developing labor saving devices and improved methods.

Years ago many men were fired—thrown in the scrap pile just like broken castings. Now we weld the castings and it is a part of the foreman's job to use the same principle with his men. The old practice of hiring and firing is obsolete. It is now a case of taking what men we have and training them to do the job. In order to do this a foreman must be interested in the men and have their respect and confidence. He must be fair and square and play no favorites. It is a foreman's job to study the individual and figure out what method to use to accomplish the desired results. As a mechanic, he learned that rounded fillets must be left without a scratch to prevent a growing fracture. As a foreman, he must learn that when he corrects a man he must not leave him with a sense of injustice or injured feeling because this

will also develop into a growing and lasting fracture.

Boilermakers know that boilers must be inspected periodically, sometimes given a hydrostatic test. Men are really no different. A human being needs checking just the same as a locomotive boiler, following up with the necessary repairs.

The average man is fairly easy to handle and responds quickly to suggestions. A foreman must be big enough to encourage suggestions—not close the door to improvement. A foreman who "knows it all" is headed for the scrap pile. When a workman comes in with a grievance it should be carefully listened to. He should be given a chance to tell his whole story, realizing that he will feel better after having told it. If there is nothing to the complaint the man should be persuaded that such is the case. If, however, there is merit to his contention, it should be rectified. If it is not rectified, it will grow like the scratch in the fillet.

Those of you who are roundhouse foremen have often been called into a huddle to try to locate the reason for a locomotive not doing well or the reason for continued breakage of parts, and it is to be expected that after you have made a careful investigation you finally located the trouble and remedied it. Similarly, there are some men in almost every organization who are hard workers but who seem to get into trouble continually through doing their work the wrong way. They are stubborn and sometimes ordinary treatment does not straighten them out. These cases need special attention and if the supervisor can convince such a man that his trouble is likely to be caused by acting before he thinks, he can undoubtedly train him to think out what is going to be done first and then the job will be done right. The point is, we give careful consideration to the inherent defects of certain locomotives because of materials or design or workmanship and the matter is studied by experts. Do you give similar thought to straightening out either foremen or men?

Handling Men the Supervisor's Big Job

Handling the human element is the most important job of the mechanical supervisor. Colleges are turning out bright engineers who are keeping apace with the latest engineering practices and materials. Manufacturers are turning out improved machines and tools. But the handling of the human element is in the hands of the mechanical supervisors. In some shops on some railroads this has been sadly neglected. In this respect railroads are probably behind industry as a whole.

Once a year most railroads make a budget. Mechanical officers ask for new facilities, perhaps for new locomotives and cars, at least a few new machines, grinders, shapers, welders, etc. Possibly in late years most of them have been cut off of the list but undoubtedly a few improvements have been made. Do you ever attack the question of supervision and morale in the same way? Have you ever thought out what you need to make an improvement, then how to go about getting it and what would be its cost? It might be a worthwhile investigation.

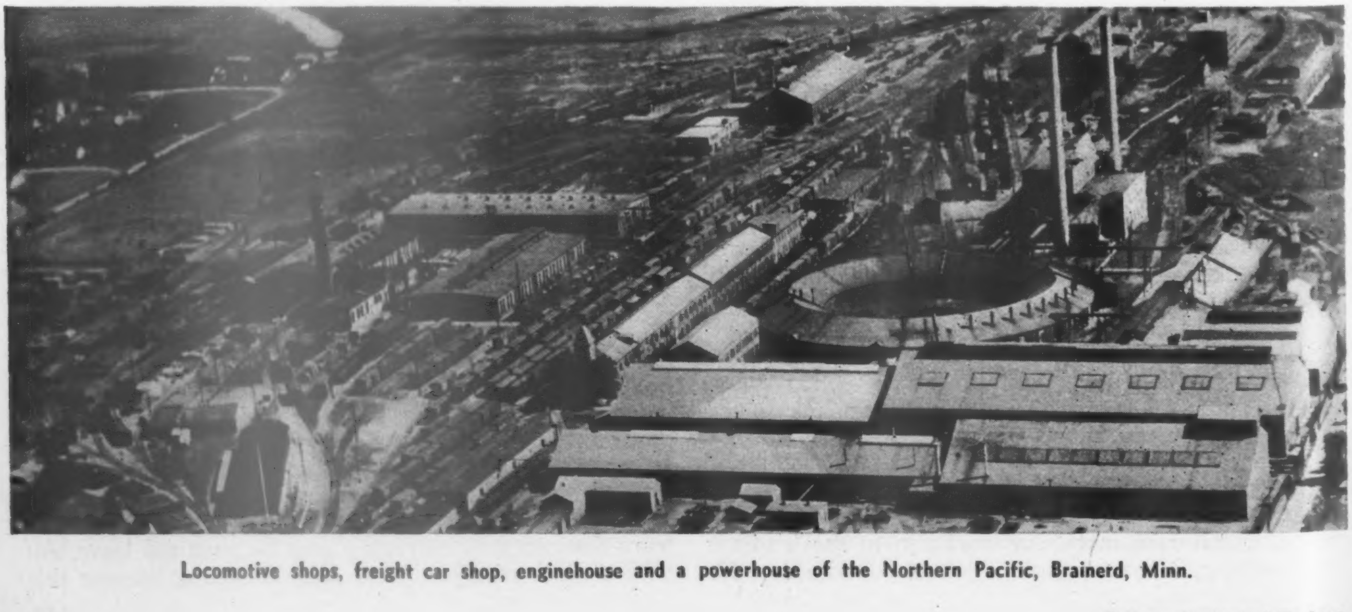
In the first place, the boss of the shop must be the leader. He must train himself to be a good diagnostician and a good leader of men before he can act as a school-teacher for those who report to him. How can this be done?

There are many helpful sources of information. First, there is the experience of older supervision; foremen's training courses; correspondence school courses; in some cities there are night courses. There is a surprisingly good sample of what can be obtained in the set of six little pamphlets which the National Safety Council has recently issued, entitled "The Human Side of Safety in Foremanship." They are well written and give very practical illustrations of how to influence men along the right lines. The cost is nominal and I have yet to hear of an officer who has not become enthusiastic over them.

In conclusion, it cannot be emphasized too strongly that the proper handling of men and consequent improvement in morale has not been given adequate attention. It is a matter that is causing serious concern to railroad managements. The present unrest caused by rival unions more strongly emphasizes the hope that our men in shops can keep their heads, not be swayed by radical propaganda and at the same time use their influence and votes toward the end of protecting the industry which provides them with their livelihood.

No railroad can have a greater asset than good foremen and supervisors, with all that they mean to morale. And remember that mechanical supervisors are promoted *not* because of their ability as machinists and boilermakers, but primarily on their ability to lead and train men, and their greatest asset is to be known as good managers of men.

* * *



Locomotive shops, freight car shop, enginehouse and a powerhouse of the Northern Pacific, Brainerd, Minn.

How Long Can We Put Off Training Men?

Little has been done to establish standards of intelligence, ability and performance

By H. J. Schulthess

Chief of Personnel, Denver & Rio Grande Western

Let's not put this off any longer!

The greatest undeveloped resource we have left on our American Railroads today, is the human element. Generally speaking, this vast undeveloped resource is a veritable gold mine that has not as yet been tapped. What is the ultimate goal of any railroad as a whole? In my opinion, it is to handle the business it gets most expeditiously, most economically, and most safely. With our present facilities, the greatest single factor in the accomplishment of this ultimate goal is the human element.

When it comes to material things, the railroads have taken the lead among other industries in the setting up and establishment of material standards, and we have made real progress along these lines. When we buy some new motive power, rolling stock, rail, or almost anything, we are very particular about the specifications of every detail. We know the specifications and insist that they be met. We know considerable about the crystalline structure of various metals and their actions and reactions under varying conditions. We know considerable about welding various metals. We are constantly trying to better material things. If a casting or some part is found to be weak, we try to strengthen it. If some part on a locomotive or car fails, we make an exhaustive study in trying to determine *why* it failed, and we take steps to correct it, so that there will not be a recurrence of the same kind of failure. Apply these same principles to the human element, if you please, and then ask the question, "How much do we know about our employes, even those who have been in service for years?" Very little. "How much do we know about the human specifications of new employes who enter the service?" Practically nothing, except for the fact that they passed a physical examination.

No Specifications for Human Material

When it comes to the human element, it is sad but nevertheless true, that little or nothing has been done to set up and establish human standards, such as standards of intelligence, standards of knowledge, standards of ability and performance.

On how many railroads today, do we have proper entrance standards and certain human specifications for new employees? If we tried to find out as much about a new employee whose services we are purchasing, as we do about a machine tool or some other equipment that we are about to purchase, I am sure that our efficiency would be much higher than it is today. Good tools are of little use in the hands of poor mechanics. In the hands of good mechanics there is practically no limit to their usefulness.

Have we not failed to recognize the fact that, even though we had the best motive power, rolling stock, shops, enginehouses, roadbed, track, signal equipment, etc., that money can buy, our efficiency and the kind of service we render is governed solely by the human element?

The human element is the largest single item in any railroad budget. It represents approximately 46 cents of every dollar of operating revenues received by the Class I Railways in the United States. This item is seldom, if ever, discussed in a budget meeting. It would seem that the importance of the human element would also warrant appropriations for the maintenance of this item. We have maintained many locomotives and cars on our railroads that have been in service for years, and have striven constantly to modernize them by adding various new and improved appliances. What have we done to modernize the employees who have been with us for years? Is it not just as important to modernize them? You may say that this is the responsibility of each employee. But is it? I think it is the responsibility of management. Most employees are ambitious, and are willing to conform to any reasonable standards set by management, if management will take the initiative in encouraging them and at the same time make it possible for them to conform to the standards set.

Of all the departments that make up a railroad, I believe that the mechanical department is probably the outstanding example of the need for new and higher standards. We cannot hope to bring about new and higher standards, still better leadership, more intelligent supervision, and higher skill in the arts of craftsmanship, until we have a definite program for attaining these desirable ends.

Minor supervision, although intensely interested, can do little to bring about such a program except through the power of suggestion to the men at the top. The best program possible will not function efficiently or effectively unless the men at the top are sold on the idea and recognize the very important part that the human element plays in efficient, economical, and safe operation. The success of such a program requires the coordinated co-operation of every officer and supervisor.

In order to attain some of the desirable ends mentioned, there are certain fundamentals which must be considered and they should be considered in proper sequence. There should be certain entrance standards for each class of employee in the mechanical department. Each step in promotion may include additional standards.

Apprenticeship Essential for Training Continuity

It is only through apprenticeship, and proper apprentice training with assured continuity, that we will be able continually to set up new and higher standards of craftsmanship. This cannot be done with the older mechanics now in service. It must be done by the new blood injected into the organization. If we want future well trained supervisors, we must begin by properly training our apprentices today. In order to become a real leader a man must first learn to be a good follower.

Apprenticeship was practically abolished on our American railroads during the depression, and as a result we have a shortage of master craftsmen today. Some of the things we did four and five years ago vitally affect us today. The things we do today will vitally affect us four and five years hence, and even longer. It takes approximately four years for an apprentice to serve his apprenticeship. Thus, if we are to provide future mas-

ter craftsmen for 1942, and from then on, we must start the training of apprentices today.

The most logical and practical way of approaching the problem of training locomotive and car-department mechanics and supervisors is to start at the beginning and inaugurate an intensive and modernized system of apprentice training. To attain the desired results, such a system must be established on a firm foundation with an assured continuity. Due to the fact that the full benefits of such a training program are not attained for many years, it calls for intelligent, long-time planning.

The full quota of apprentices under the allowed ratio should be maintained. Many mechanical-department officers and supervisors have had a mistaken idea that there were at times, too many apprentices. They were wrong, and I will try to prove it to you. According to an accurate survey, which I made personally, and which covered several railroads and a period of many years, I found that only 36 apprentices out of every 100 indentured eventually completed their apprenticeships. Assuming that the allowed ratio of one apprentice to five mechanics was fully maintained—and it was not—on the roads on which this survey was made, this would graduate only enough apprentices to provide for an average yearly turnover among mechanics of 1.8 per cent. The normal average yearly turnover among mechanics is at least 4 per cent.

The erroneous impression about there being, at times, too many apprentices, was probably formed because many railroads did not absorb all of their graduate apprentices. This was due to the fact that they promoted helpers to mechanics and employed new men as mechanics whose only previous experience was as helpers on other railroads. This had a very bad effect on the morale of the good mechanics and a still more detrimental effect on the morale of apprentices.

Most railroads now have a ratio of one apprentice to every five mechanics, and if our shop craft organizations would thoroughly analyze this ratio, they would probably ask for a ratio of one apprentice to every four mechanics instead of one apprentice to every ten mechanics.

Applicants for apprenticeship should be carefully selected and should be given an entrance examination in order to determine their fitness and whether or not they have the mental capacity to assimilate technical training. In the past, many railroads have taken only those young men who have applied to them for an apprenticeship, instead of going out after the most desirable applicants.

Many young men who are naturally gifted along mechanical lines and who on their own initiative are attending trade and vocational schools; who already know how to read blueprints and make an intelligent freehand sketch; who can tell the difference between a lathe and a boring mill; and who are not fooled if someone tries to send them after a left-handed monkey wrench, would be glad for the privilege of serving an apprenticeship if given the opportunity. Believe it or not, some of these fine young men do not even know about the opportunity of apprenticeship on our railroads. No one has told them about it. If the supervisor of apprentices will visit some of these trade and vocational schools and talk to the senior class about the opportunities of apprenticeship, he will have more applicants than he can use.

Master Craftsmen the Objective of Apprenticeship

A modernized system of apprentice training should give an apprentice every opportunity to learn all branches of his trade in order that he may become a master craftsman. Shop schedules for apprentices—the moving of an apprentice from one operation to another—should be worked out for each craft, in line with the facilities at each shop point where apprentices are employed. If we want to make master craftsmen, we must also give apprentices a thorough and intensive technical training, because there are many things which they cannot learn by practical experience alone, and they will be only about half as efficient if we do not include a technical training as a part of their apprenticeship. The technical training for apprentices should include a thorough training in the fundamentals common to all mechanical-department shop-craft work. After completing these fundamentals, the training should be highly specialized for apprentices in each craft on the technique of their craft work. There should be no discrimination between crafts. By that, I mean that if there is only one upholsterer apprentice on the railroad, he should be assured the same thorough training pertaining to his craft as a machinist or a car-builder apprentice, in which crafts most of the apprentices are employed.

The training program should include every apprentice on the railroad, no matter where located, and should be designed so that there is as little interference as possible with shop routine. It should be supervised by a competent, qualified supervisor of apprentices who should be on the staff of, and report directly to, the chief mechanical officer of the railroad. Definite records should be kept on the progress of each apprentice, both in his shop work and in his technical training. In the latter, he should be required to qualify on a monthly progressive study schedule. Each apprentice should be rated monthly on his shop work and on certain personal characteristics by the foremen under whom he has worked. This rating sheet should be approved by the general foreman and the master mechanic or shop superintendent.

After standards of craftsmanship have been established through apprenticeship, then, and not until then, can we expect mechanics in the locomotive and car departments to conform to these standards. The mechanics then have definite incentives and will respond either on their own initiative, or by suggestion, to a post-graduate training program outlined by management, provided it is practical and is suited to the needs of each mechanic.

As I mentioned before, we know considerable about

"If we are to provide future master craftsmen, we must start training apprentices today"

the crystalline structure of various metals and their actions and reactions under varying conditions. How much training have we given our supervisors to enable them to know something about the actions and reactions of the men they supervise under varying conditions? I have mentioned that good tools are of little use in the hands of poor mechanics. And the same thing is true about good mechanics in the hands of poor supervisors.

Supervisors Need Special Training

The training of supervisors is the keystone in the entire training program. I do not mean that we do not have good supervisors, but I do mean that there is not a single supervisor who cannot become a still better supervisor.

Again, it is sad but true, that we still promote men to supervisory positions very much the same way we did 50 years ago. Generally speaking, when a man is first promoted to a supervisory position, he makes the transition over night from an employee to an employer without any specialized training in the multitudinous problems of supervision and with little, and sometimes no, definite fore-knowledge of his new duties and responsibilities, and particularly the desirable ends he is expected to accomplish in the position to which he has been promoted. There should be a definite program for the selection and training of understudies for supervisory positions, which should also include men now in supervisory positions who are considered good material for promotion to higher supervisory positions. There should be at least two understudies for each supervisory position in order that the selection in filling a vacancy may be made on a competitive basis.

If management on our American railroads will analyze the problems mentioned, it is bound to arrive at the conclusion that the further development of the human element is not only highly desirable but absolutely necessary if we are to keep pace with progress and keep adaptable to meeting constantly changing conditions.

How long can we put off training men—locomotive- and car-department mechanics—supervisors? Only until the men at the top recognize the wisdom and necessity for doing these things and give their whole-hearted support and co-operation to such a program.

The D. & R. G. W. Apprentice Club

And now I would like to tell you something about what the Denver and Rio Grande Western is doing along these lines. I am sure you have all heard of the "Scenic Line of the World." I am proud to say that the trustees of this railroad, Wilson McCarthy and Henry Swan, as well as other officers, recognize fully the importance of the human element and are giving their wholehearted support and co-operation to the program we have started.

The apprentice-training program mentioned is in operation on this railroad and is functioning smoothly and efficiently. We have an outstanding apprentice club at each shop point where apprentices are employed. The apprentices elect their own officers and the meetings are conducted by them. One of the things that these apprentice clubs accomplish is the broadening of an apprentice's knowledge of railroading in general. The principal speakers at these apprentice-club meetings are officers and supervisors from the different departments, and sometimes representatives of railway supply companies. The superintendent tells the apprentices something about his problems and the work over which he has supervision. After he has finished, the meeting is thrown open for discussion, and the apprentices are not a bit bashful about asking questions. Other division officers, such as the master mechanic, division engineer, trainmaster, chief dispatcher, division storekeeper, road foreman of equipment, various shop foremen, etc., do the same thing. At some meetings demonstrations are given and sometimes motion pictures and slides are shown. These meetings have proved so interesting and educational that many of the supervisors and mechanics also attend.

At the last apprentice-club meeting in Denver the meeting was attended by the trustees, the vice president and general manager, the chief mechanical officer, the general auditor, the purchasing agent and general storekeeper, the superintendent of transportation, the superintendent of telegraph, the engineer of tests, the mechanical engineer, the supervisor of safety and fire prevention, the commerce counsel, the valuation engineer, the state supervisor of trade and industrial education, the principal of the vocational training school, the co-ordinator of the Denver public schools, the division superintendent, the master mechanic, the trainmaster, and many other officers and supervisors too numerous to mention, in addition to over one hundred apprentices. Have you ever heard of anything like this before in the history of railroading?

All of the things mentioned can be done and I believe will be done. While we have made a start, we realize that we still have a long way to go, and I hope that in the continuation of our work along these lines we will always be mindful of the fact that:

"To know what to do is WISDOM.

"To know how to do it is SKILL.

"To do it as it should be done is SERVICE."

Freight Car Repairs on the Lackawanna

Brief description of the methods in a dead-end shop where men rather than cars are moved

By J. Thompson

General foreman, Delaware, Lackawanna & Western

I believe it would be interesting to explain the layout of the Delaware, Lackawanna & Western Keyser Valley car shops, located on the outskirts of Scranton, Penna., approximately 135 miles from New York and 262 miles from the western terminal, Buffalo, N. Y. The shops were located at this strategic point in the heart of the anthracite coal region as all coal carrying cars are handled in and out of this territory. The entire plant layout covers 83 acres and comprises seven main buildings, consisting of the machine and blacksmith shop, saw-mill, two car repair shops, paint shop and annex. The buildings are 33 years old and improvements have been

added from time to time and they are still suitable for present requirements. In addition to the above there are two auxiliary buildings, one a modern oil and waste reclamation plant and the other a brake beam assembling and dis-assembling machine, tension rod bending machine and a testing machine.

The storage space provided has a capacity of 500 cars.

Recently 450 wood side gondola cars were converted to steel-sided gondolas, making them all steel with the exception of wood floors and stringers. Following is a description of the work. Dead-end shop tracks necessitate the progressive movement of the men rather than of the cars. The first operation is to remove the side planks, floor sills and side stakes.

Next the cars are sent to the steel track where all deteriorated parts are removed and renewed, the couplers and draft gears removed, inspected and renewed where necessary. All other parts are then inspected and renewals made as required, complete reworking of the trucks is done at this time, the air brakes are given a general overhauling and pipe work completed. All rust and scale is removed from the underframe after which it is given one coat of red lead.

The next operation is that the bulb angles, side sheets, and stakes are placed in the jig, fitted and riveted ready for application to the side sills of the cars.

The sides are then lifted by an overhead crane and placed against the sills, then fitted and riveted to the present steel side sills, end gate and locks are applied in this position.

As the cars pass out of the shops, the underframe and sides are sprayed with one coat, which saves a day at the paint shop. The cars are then placed in another shop for application of wood stringers and floors, after which they are placed in the paint shop for a second coat of paint, the cars are then weighed and stencilled and are then ready for service.

Rebuilding of 450 Box Cars into Steel Auto Cars

The operations in rebuilding an 80,000-lb. capacity wood-sheathed box car into an all steel automobile car are also interesting and will be described briefly.

The first operation was to remove the roof, wood side sheathing, lining, floors, wood posts, and braces, etc.

The next move was to place the cars on the steel track where all parts were inspected and those found defective were removed and replaced with new parts. The couplers and draft gears were removed, inspected, and renewed where found necessary.

This procedure was followed for all parts of the car. All rust and scale was removed from the underframe, after which all parts were given a coat of red lead. The air brakes were given a general overhauling as well as inspection and completion of the pipe work and complete re-working of the trucks in this position.

The assembled steel sides were then hung on the car, using a locomotive crane. One of the interesting features was that the steel sides were removed from the car in which they had been shipped and placed directly on the car. The steel carlines, ridgepole and purlins were fitted and riveted in a jig located on the ground and when completed placed on the cars by a locomotive crane.

In the next operation the car was squared, fitted, reamed and riveted. The door tracks were also fitted and riveted in this position.

The floor stringers, floor, side posts, door and corner posts, roof, grain strips, end lining nailers and all lining was then applied. The application of the safety appliances was made while the car was in this position.

The cars are then sprayed with two coats of paint. The door posts and the inside of the steel doors are also given a coat of paint.

The cars are weighed and stencilled, after which they are ready for service.

Mechanical Supervisors and Public Opinion

Many things can be done to cultivate more friendly relations with the public

By Roy V. Wright

Editor, Railway Mechanical Engineer

Industry—and in a broad way it includes our transportation system—is on the spot today! In spite of the fact that private management in industry and on our railroads has been unusually successful in developing our national resources and giving our people by far the highest standards of living of any country in the world, much dissatisfaction prevails and politicians and theorists are attempting to take over the task of directing and managing them. Despite, also, the obvious gross inefficiency in government administration, some of the railroad labor leaders are openly espousing government ownership of the railroads; others are not going quite so far, but are pursuing tactics, which, if successful, will force more of the railroads into bankruptcy and may bring about government ownership, whether it is the desire and will of the general public, or not. Steady heads and courageous hearts are necessary on the part of our people, if we are to come through the storm safely.

Many of the railroads have well established departments, the objectives of which are to keep the public informed about railroad doings and cultivate a friendly spirit toward the railroads. As you very well know, the Association of American Railroads recently embarked upon an ambitious program in the attempt to demonstrate the advantages of the railroads to the public and to bring about more friendly relations. American industries are following suit, continuing their intense sales advertising programs, but also at the same time giving more and more attention to educating the public as to their importance in the economic life of the communities in which they are located and the vital part they play in American life as a whole. This new emphasis is necessary in the effort to bring about better and more intelligent understandings and to prevent unfair legislation and regulation, by bringing informed public opinion to the support of the industries and holding in check unscrupulous and short-sighted politicians and thoughtless demagogues.

The great problem in industry and on the railroads is to educate the employees as to the actual conditions and

some of the handicaps under which their employers are laboring, and to inspire and stimulate the employees and supervisors to get these facts over to the public. This has been accomplished remarkably well in a few places, but very little, if at all, in others. In the short time at my disposal this afternoon I shall attempt to point out a few ways in which the supervisors and foremen can render constructive and worthwhile service in this respect.

Too frequently the newspapers and the public have little or no appreciation of the number of employees and the size of the payroll of a railroad repair shop, or of a locomotive terminal, or of a car repair yard; nor do they understand the heavy taxes which the railroad must pay to local, state and federal governments.

When the money paid to the employees in a particular community is broken down into the amounts spent for different kinds of food, or clothing, or rent, or other important items—and the newspapers will usually be glad to print reliable facts about such matters—it awakens the tradesmen and professional men to the advisability of doing their part in conserving such an asset.

The industries of an eastern community recently banded together to collect and disseminate such information about their operations collectively; they found the press glad to receive such data and to comment upon it editorially. Railroad employees and taxpayers organizations in some localities have gotten excellent results in cultivating a more favorable opinion toward the railroads in just this way, but unfortunately, too few groups have taken part in such campaigns.

Plant Visitations

Probably you do not realize it and quite possibly, also, you may not wish to incur the trouble, but considerable numbers of the public will gladly avail themselves of invitations to visit your shop or enginehouse or other facilities, or to inspect a new or rebuilt piece of equipment, such as a car or a locomotive. This experiment has been tried out in a number of places in the past few years and with surprising and gratifying results. One railroad repair shop has a standing invitation out for groups, properly organized and conducted, to visit its plant. Many school classes or organizations, such as troops of Boy Scouts, have taken advantage of this invitation.

A boy or girl, telling at the supper table of his or her observations and experience in making such a trip, may have a strong influence in making the parents more sympathetic and more interested in the welfare of the railroad. Such visits are reflected, also, back in the classroom, by a desire for more information about the railroads; and any unbiased study of the conditions under which the railroads operate and of their contribution to the general welfare of the public, will surely redound to the interests of the railroads and their employees. There are incidental advantages, also, to such inspection trips by the younger people, or by older ones as well. The employees are inclined to spruce up and give greater attention to the appearance and cleanliness of their machines and surroundings, and as you well know neatness and cleanliness are usually associated with improved efficiency and production.

Exhibiting New Equipment

Railroad managements have been amazed at the interest which the public has taken in the new streamline trains when they have been placed on exhibition, or even in new or rebuilt cars and locomotives of the ordinary types. Here is a great potential asset, which has been lying practically dormant, for making people railroad-minded, and yet it can be realized upon with comparatively little expense. The difficulty, as I see it, is that we have construed our responsibilities too narrowly. We have concentrated on repairing and maintaining the equipment and have lost sight of the fact that in our own selfish interests we have a real selling job to do. If we do not all do our little part in cultivating a more intelligent and favorable public opinion toward the railroads, this vital and fundamental part of our national transportation system may function so poorly, because of lack of public support, that our jobs and those of great numbers of employees may be seriously jeopardized; indeed, I have so great faith in the important part that the railroads play in our national economy that I truly believe the public will be the principal loser, and this largely because we have failed in properly educating and cultivating it.

Support from Railroad Fans

I wonder how closely you have followed the development in many sections of our country of running special trains over week-ends to visit railroad facilities. Such trips have been largely inspired by outsiders; indeed, it was rather interesting to note the reluctance of some railroad managements in meeting the demand for such tours. It has been a revelation to find the great number of people, not boys and girls, but grown-ups, including men prominent in business and professional life, who seem to find as much satisfaction in making such trips as does the small boy in visiting the circus. Moreover, most of them have a surprising knowledge and understanding of the different types of equipment and facilities and their details. It may be a hobby with them, but they certainly do go to the bottom of things and many of them are simply "nuts" on the railroads. I have known some of them—not railroad employees, mind you—who will not buy materials that they know are not shipped by railroad. Surely such people are well worth cultivating, but are you doing so?

Railroad Model Makers

There is another class closely allied to these railroad fans, and that is the model makers. Recently in a city of about 150,000 inhabitants, I found a group of 57 of these model makers, with a well-equipped headquarters in a factory loft. Incidentally, they were much disturbed because of the delay, due to economic conditions, in the revision of the Locomotive Cyclopedia. Most of them were engaged in making models of railroad equipment. Apparently they have different grades of membership, just as do some of our engineering societies, depending upon their proficiency and the standards to which they have advanced in making models of railroad equipment.

A nuisance, you may say, if they bother you too much for information about the details of your equipment, but what an asset they may be in fighting with the legislators and demagogues for a square deal for the railroads. I have found some of them who could make a more effective and logical defense of the railroads than most railroad men—yes, than many railroad officers—and it is all the more effective because it comes from men not dependent on the railroads for a livelihood. Use your imagination and in dealing with such men recognize their potential possibilities as friends of the railroads.

Railroad Employees and Taxpayers Associations

There has arisen in recent years a movement which we must not overlook and which is deserving of our support. Numerous railroad employees have awakened to the fact that a politician who is supposed to be in

favor of organized labor, but who at the same time does everything he can to put the railroads out of business, is a mighty poor friend of the working man on the railroad. In short, railroad employees are beginning to understand that, if they want to keep their jobs, they cannot continue to vote for candidates simply because they are pro-labor, but they must also demand that they be pro-railroad as well. That is to say, a candidate to be a real friend of organized railroad labor, has got to be a man in favor of regulating competing agencies of transportation. He must be an opponent of excessive expenditures on highways and waterways. He must favor the Pettengill bill to abolish the long-and-short-haul clause of the Interstate Commerce Act. He must favor adequate fees for the use of public highways by commercial motor vehicles.

If a politician does not stand with the railroad working man on these questions, but still claims to be in favor of high wages and favorable working conditions on the railroads, then he is simply offering the railroad employee a fancy piece of frosting with no cake underneath. Because high wage rates and short hours on the railroad mean nothing unless there are some railroad men working under those conditions; and railroad men will not be working under these or any other conditions if the bulk of railroad traffic is unfairly diverted to the highways and waterways.

I say that the railroad employees are waking up to this situation and that as a result of their waking up the handicap to the railroad industry having no vote will soon be a thing of the past—provided, that is, that the employees are given a reasonable opportunity to organize politically for the defense of railroad traffic and railroad employment.

Five or more years ago there began to be organized in various parts of the country organizations of railroad employees known variously as "Railroad Employees and Taxpayers Associations," "Ship by Rail Clubs" and "Railway Employees and Citizens Leagues." These organizations met with varying success. Usually where the organizations received the sympathetic co-operation of railway managements, they were able to play a substantial part in getting on the statute books favorable legislation for the adequate regulation and taxation of railway competitors. Just to cite one example—Kentucky—railroad employees, both organized and unorganized, working in complete harmony with railway managements, were largely instrumental in getting on the statute books a law which prohibited trucks of over nine tons gross weight from the highways in that state. Similar legislation has been secured in other states by the same procedure.

Some managements have been unduly afraid of these employee organizations, fearing that they might be used for anti-railroad purposes, such as full crew laws and the like. Similarly, some of the labor executives have been suspicious of this activity for fear that it would be used against the labor organizations. However, as a matter of actual experience, in those states where the managements and employees have dealt frankly with each other, recognizing that they had some interests which were not mutual, both sides agreeing not to use this joint effort for any selfish partisan purpose, the plan has worked out without any cause for criticisms by either organized labor or management having arisen.

It is my belief that railroad managers and supervisors should give every aid which they consistently can to legitimate efforts on the part of employees to protect their jobs by political action in defense of the railroad industry. If the managements will play on the square with the employees and organized labor in a movement of this kind, I believe they will have no difficulty with these organizations developing in an anti-management direction.

Certainly the railroad industry is today a target for all kinds of unfavorable political action. An industry cannot defend itself or command the respect of politicians unless it has some votes to back it up. Where can the railroads hope to get the necessary votes if not among their own employees? The alternative of discouraging employees in this activity and allowing the situation to drift, is one of certain disaster for the railroads, because highway and waterway competitors have got votes and are using them against the railroads. If the railroads will not co-operate with their employees to have the employee vote used in behalf of the industry, then the outlook is black indeed.

Right here in Illinois there is one of the most active of these employee organizations. They also are operating in perhaps a dozen or more additional states. I can think of no better way in which the members of this association could exert themselves for the preservation of the railroad industry than to get acquainted with employees who are interested in activities of this kind, and co-operate with them in every legitimate way.

A Good Advertisement

In the statement which I am about to make I beg of you not to misunderstand me. It is not my purpose to criticize, but rather to attempt to make helpful and constructive suggestions. Anyone who was a close observer of railroad activities during the depression years could not but be impressed by the loyalty and the dogged persistence with which the supervisors and foremen in the mechanical department fought against heavy odds for the preservation of the railways. For this they are entitled to the greatest amount of credit.

With this appreciation as a background, let me state that one of the best assets in building good will toward an institution is a body of capable and satisfied employees. You may argue that wages and working conditions are largely beyond your control, since they are arrived at by collective bargaining processes, and that these are important factors in making for satisfied employees. You cannot sidestep the fact, however, that the supervisors in charge of the shops and the various departments are really the vital factor in building up the morale of the group under their direction. What about you, yourself? Are you a successful administrator? Are you constantly studying and striving better to understand your men and to educate and inspire them to more intelligent effort? What about your shortcomings and faults in dealing with other people? What are you doing to overcome these shortcomings and to improve your performance in contacting with your associates and your subordinates?

Walt Wyre is one of the very few writers in railroad technical publications, who has the ability to dramatize and present important facts about railroad operations and practices in story form. Walt Wyre made good as a journeyman after a strenuous apprentice training. Later on, when he wanted to take up literary work in his spare time, he faced certain facts fairly and squarely. It had taken him four years to complete his apprentice training in his trade and then he was only just well started. He decided that it would take at least that much time to train himself as a writer and start to capitalize on his product, and he went at it in that spirit. He had natural talent, but he has made good in becoming a master in his art by hard and careful study and critical attention to details.

Most foremen and supervisors worked hard to mas-

ter their trades as craftsmen, but have they given an equal amount of study and thought to the art of directing the human element—a far more complicated and difficult problem than that of dealing with materials?

The task of successfully directing the human element is a real art and profession, although this has not been recognized as widely as it should have been. The rules of the game, or the fundamental principles, are now thoroughly well understood. It is true that much depends upon the native ability of the supervisor, but much also depends upon understanding the art and of knowing how to practice it. There are plenty of opportunities, if one is on the alert to learn of these principles and how they should be applied. Good books, study courses, classes and discussion groups in foremanship and other means, are at hand. I have seen foremen who were only just getting by, speed up and make real records when they undertook studies of this sort.

Interest Yourself in Community Affairs

One fine thing about many of our railroad supervisors and employees is that they are unusually good citizens, and because the railroad is judged in the local community by its representatives, its reputation is thereby enhanced. Then, too, foremen and supervisors who come in contact with other people active in civic affairs, are in a position more or less informally to interpret the policies of the railroads and its needs to these people. We live in a democracy, and in the last analysis the people rule. A democracy in these days, however, must be representative and the responsibility of governing the community must be largely entrusted in the hands of a comparatively few key people. Railroad supervisors interesting themselves in and taking part in community affairs, not only make an impression upon the entire community, but will naturally contact more intimately with the leaders in civic affairs, who can be most helpful, if they have a proper understanding of railroad conditions.

I might go on in great detail, but I think I have said enough to indicate that there are almost numberless opportunities for railroad officers and supervisors to contact favorably with the public and to assist in bringing about better understandings and more friendly relations between the railroads and the public.

Can Modern Machine Tools Cut Repair Costs?

Costs could be cut with the aid of studies and operation records to determine logical replacements

By L. H. Scheifele

Tool and Material Supervisor, Reading Company

The question "Can Modern Machine Tools Cut Repair Costs" could be positively answered in a few short sentences and be justified and proven by the experiences of many present day users of modern machine tools. However, before deciding and recommending which of existing old machine tools should be replaced with modern equipment, the requirements should be carefully studied.

How should this study of requirement be approached and what should be the deciding factors governing the purchase of new equipment. First, we should study our entire operation. Select the key machine in this operation and determine whether or not this machine is producing to its maximum capacity. Having satisfied ourselves on this point, the next thought should be, will a modern machine tool improve production, if so is there sufficient volume of work available to justify its purchase? Many of us who have been associated with machinery most of our lives, have an innate love and admiration for a new machine tool lately designed and equipped with the latest mechanical features. Because of this natural attraction we are very liable to recommend such a machine tool out of sheer admiration for its mechanical appeal, without properly considering whether or not we have sufficient volume of work to warrant its purchase.

Having studied the key operation, the next thought should be, how will the existing supporting or minor machine tools fits into a program faced by a modern machine tool. This factor should be handled in the same manner as previously discussed when considering the key operation.

Having decided which machine tools should be replaced with modern equipment, the next thought is which of the many new types of modern machine tools will best fit into your program.

All of us who are charged with the supervision of machine tools or their operation, should be continually scouting for improved methods and equipment. Unfortunately, this phase of our work is sometimes suppressed by company policy or by our own, allowing matters to take their course, attitude.

And now, if you will pardon me, I would like to relate the experiences of the Reading Company in connection with a comparatively recent machine-tool replacement program.

I need not remind railroad men that along with all other industries the railroads were very drastically affected by the recent business depression. Consequently, it became essential that economies be effected in all departments of railroad organization. Maintenance of equipment ratios were trended downward, while at the same time operating efficiency and equipment design were trended upward. The Reading Company accepted this challenge of a new era, and sought ways and means to meet these two opposite trends. In order to do its full share in effecting economies, the Motive Power Department of Reading Company made a survey of its entire machine tool equipment, beginning early in 1933. This survey disclosed there were 730 machine tools in the Reading Shops whose average age was 30.9 years.

Having carefully studied the machine tools on key operations as well as those on supporting operations, it was quite obvious to us that we could not produce quality workmanship and effect the necessary economies with this type of machine tool equipment. Quality workmanship, more than ever is essential to meet higher train speeds safely and to reduce road failures. Both of these factors improve efficiency and assist in attracting business. Economies and consequent earnings are essential in order that those who finance railroads and industry, may remain interested.

What Equipment Can Be Replaced?

The next problem was to decide which of the obsolete machine tools should be replaced first. This problem was attacked by studying modern machine tools in operation in other railroad shops and kindred industries; also by visits to various mechanical shows and working exhibits. The data obtained from these sources provided the necessary basis for an intelligent machine tool replacement recommendation and estimation of savings which could be effected.

A program recommending the scrapping of 50 machine tools, whose average age was 33 years, and the purchase of 37 machine tools at an estimated cost of $227,000, was submitted to the management. The savings, based on full time operation, i.e. 26 double-shift working days per month, which could be effected with the 37 machine tools recommended, was estimated as 26 per cent. This program was approved March, 1935. Specifications were drawn up and after analyzing many bids, requisitions were submitted during June, July and August of 1935. All 37 machine tools were purchased and in operation by March, 1936. These machines are equipped with various types of cutting tools, each chosen after detail study had proved it to be the most economical for a particular operation.

This might appear to be the happy completion of a fine program. However, we were still confronted with the problem of properly manning the new equipment efficiently in order that their potential savings over the old equipment, might be realized. The ranks of the young mechanics who are most readily adapted to changes in practice and machine tool operation, were depleted on account of seniority rules governing reduction of personnel made necessary by business conditions. Also the apprentice system was inoperative for the same reason. However, by patient supervision and instruction, the older mechanics were trained to operate the new machine tools efficiently.

The natural question at this point, no doubt, is what actual savings have been effected with the 37 new machine tools, how were they arrived at, and how do they compare with the estimated 26 per cent return, based on full time operation?

The first year's required operation of the new machine tools was only 43 per cent of full time operation. In spite of the shortage of work and the fact that workmen had to be gradually accustomed to new methods and tools, the actual savings was 17 per cent. You can readily see that were full time operation available, a savings of approximately 39 per cent could be effected. To date, at no time have these machines worked more than 48 per cent of full time operation, however, the average monthly savings to date have been 20 per cent. At the end of July, 1937, the accumulated savings was $71,319.79. This is 31.4 per cent of the original investment of $227,000.

These savings were determined by placing a production form on each machine. These forms are collected daily and compared with production obtained from the old machines which they replaced.

I would like, at this time, to refer to several machine tools which are outstanding when compared to old equipment which they replaced.

The Reading shop is equipped with three vertical rotary table milling machines, two of which are approximately 30 years old, and one modern machine with a 54-in. table. It requires 24 hrs. to machine two passenger-truck equalizing bars on the old machines. The same items are machined on the new machine in 8 hrs.

Locomotive main-cylinder packing rings are machined on a modern vertical boring mill equipped with side head at 100 ft. per min. on the rough cut and 150 ft. per min. on the finish cut. The machine previously used for this work could only be operated at 60 ft. per min. and frequently failed at this speed.

Metal spray equipment consisting of a steel grit blast cleaning cabinet, spray booth, two spray guns and a converted engine lathe was installed August, 1935, at an approximate cost of $2,800.00. To date the accumulated savings effected with this equipment is $6,689.60.

In addition to the program just referred to, the following additional tools were purchased during the last four years. Ninety-nine portable pneumatic tools, 31 portable electric tools, such as drills, screw drivers, nut runners, etc., 54 miscellaneous machine and portable tools.

Some of this equipment has paid for itself in six to twelve months.

There is one example of an electric crane truck costing $4,800.00 assigned to a Reading Company enginehouse, that has paid for itself after 13 months operation. There is another example of four pneumatic impact wrenches costing $1,000.00 that have effected an accumulated savings of $4,832.00, in two and one-half years.

During the last four years we have also converted a considerable number of lineshaft-drive units to individual motor drives. Eighty-four machine tools have been so converted to date.

Results of Improvements

As the result of this improvement, nineteen 50-hp. lineshaft motors, and 1025 ft. of lineshafting have been retired. In addition to lowering the cost of machine tool power, the removal of lineshafting, line shaft hangers, column brackets, lineshaft motors and countershaft timbers has eliminated the maintenance cost on these items and greatly improved the general appearance of the shops.

The experiences I have just related are amply born out in other railroad shops as well as in other industries. All of us have a daily example of an outstanding achievement brought about by modern machine tools—the automobile. More comfort and safety is built into this product than ever before and at a lower cost to the consumer. This was made possible by modern machine tool equipment. Recently a prominent figure in the automobile industry made the following statement over a nation-wide radio hook-up: During the last eight years $175,000,000 worth of equipment was scrapped by his company and replaced with $217,000,000 worth of new equipment. The result of this policy was increased earning capacity of their employes and lower cost of the finished product to the consumer.

I would like again to emphasize the importance of careful study before submitting recommendations for the purchase of new machine tools. Bear in mind that the men who have the authority to grant an appropriation for such expenditures are not always mechanical men, consequently, the recommendation should be clearly set up in a business-like fashion. The age, condition and productive capacity of the old equipment should be stated. The new equipment should be described in detail and its mechanical and economic advantages clearly stated.

After the new equipment is purchased and in operation, keep accurate records of what has been accomplished in the way of savings or improved workmanship. The data will be invaluable when requesting future new machine tool equipment.

Accident Prevention in the Mechanical Department

Supervisors are key men in training employees—Safety committee an important factor

By R. C. Helwig

Safety Agent, Delaware & Hudson

There is no cure-all for accidents; there is no beaten trail to safety and there is plenty of room for improvement in our own operation as well as in our accident prevention results.

It is generally recognized on all railroads, in fact in all industries, that supervisors are the key men in procuring co-operation among employees, which is necessary, not only for the prevention of accidents, but for general efficiency in operation as well. Men appointed to supervisory positions should fully realize their responsibilities, not only in quantity and quality production, but in economical and safe production as well. They should have the ability to detect unsafe practices and correct them before the accident happens. Just because an operation has been performed many times without accident does not imply that it is a safe method and many accidents are caused by following presumably safe practices which were actually unsafe, but the hazards of which had not been detected.

When a severe injury or a fatality occurs in any shop, the executives of that plant are always keen to do something drastic about accident prevention to avoid a recurrence. However, when a comparatively minor injury occurs, the fact is often overlooked that the seriousness of the results of any accident has nothing whatever to do with its cause and therefore, with its prevention. In other words, the serious injury and the minor injury are usually the result of exactly the same cause and both are important as an indication of the effectiveness of your accident prevention program.

After all, just what is an accident? Is it not something that happened when you did not think it was going to happen? An accident is really a mistake coming to light, and an injury is the result of an accident. Accidents do not always injure people. Statistics show us that there are about 30 accidents to equipment or material to every one that even slightly injures a human being and that there are about 300 minor injuries on the average to one lost-time injury. Strange things happen. One man may fall 30 feet and escape with a few bruises. Another man may slip on a grease spot on the floor or trip over a water hose and fracture an arm or a leg. After the accident happens, you can't control the severity of the injury. To prevent injuries we must prevent accidents and the plant that practices good continuous safety work the year around, directed at minor accidents that occur with more or less frequency in any plant, automatically prevents most serious and fatal accidents.

The Work of the Safety Committee

On the Delaware & Hudson, in all of our larger shops and enginehouses, we have safety committees, probably organized along the same general lines as the committees on your respective railroads. The usual plan is to appoint a safety committeeman for each foreman's gang and it has been my experience that each safety committeeman is just as active and efficient, so far as accident prevention is concerned, as his immediate foreman wants him to be. In other words, I believe that most of us want to do what our particular boss wants us to do and that generally the foreman's attitude toward accident prevention, as in other things, is reflected by the men working under him. For that reason I believe that the supervisor must show by his attitude and actions that he is 100 per cent for safety. This is very important. Can you reasonably expect a man working for you, to carry out safety instructions, if you do not yourself demonstrate by your own actions, that these instructions are not only practical but important? The men working for you are more apt to do what you do rather than what you tell them to do.

A safety committeeman, properly guided by the foreman, can be of considerable help to him, in setting up a proper organization to prevent accidents to the men under his supervision and after all, successful accident prevention, is largely a question of proper organization. Our foremen know that if an accident happens to a man under their supervision they are held responsible; on the other hand, if the men under their supervision work without accidents, they receive the credit for the performance. We feel that a safety record, whether it is good or bad, is the record of the men who made it. It has been our experience that the foreman who considers the safety committeeman as his assistant in preventing accidents to the men under his jurisdiction, has been most successful in his accident-prevention program.

To illustrate: Some of our foremen made it a practice to take their safety committeemen into their confidence and found the opportunity to discuss with them, for a few minutes each day, ways and means of increasing the interest in safety of the men in their gangs. They also solicited from the safety committeemen, any suggestions they might have to offer along this line. Where this method was followed, it was surprising to note the better feeling and greater interest in safety, that developed, with the result that now, pretty generally, this plan is carried out by the foremen.

Gang Meetings

Another plan which was started by the supervisors at one of our larger shops and which is now pretty generally carried out over the whole railroad, is for the foreman and safety committeeman to hold a meeting with the men under their jurisdiction, at regular intervals. This varies, in different locations, depending on the need and local conditions, from a 10- or 15-minute meeting each week to a 30-minute meeting each month. At these meetings, safety matters of interest to the men in their particular line of work are brought up and discussed and suggestions by the men, for eliminating hazards in their work, whether from unsafe conditions or practices, are encouraged. It has seemed to us that greater benefit is derived from these meetings when the discussion is limited to the members of the particular group, so it is only very rarely, and then only for some special reason, that the members of the safety department or other officers of the department involved, attend and talk at these meetings. In the first place, the foreman and the safety committeeman feel that this is their meeting and the responsibility for its success is theirs. In the second place, the general discussion on subjects which may come up

is usually more free when only the members of a particular group who continually work together are present. The minutes of these meetings are recorded and forwarded to the division officer in charge of the particular shop or enginehouse.

At one of the larger enginehouses we found that about three-fourths of the accidents were occurring on the two night tricks—namely, the 3 to 11 and 11 to 7. In view of the fact that about two-thirds of the total number of men were employed on the 7 to 3 trick, it seemed as though the night tricks, with one-third of the men and three-fourths of the accidents, were having more than their fair share of the accidents. There was a safety committee in operation at this point which met at a specified day each month at 1:00 p.m., and which included representatives from the 3 to 11 and 11 to 7 tricks, but the large majority of the members, were from the 7 to 3 trick for reasons which you can readily understand. The master mechanic decided to organize, what he called, a night safety committee, composed only of men from the 3 to 11 and 11 to 7 tricks. The meeting, held separately from the day committee, was called for 10:00 p.m. by the master mechanic, who presided as chairman. The safety committeemen, who ordinarily went to work at 11:00 p.m. came in an hour earlier to attend this meeting and the 3 to 11 members of the committee, were held over until the meeting was concluded. In a very short time after this committee was organized, the large number of accidents on the two night tricks stopped and the injuries per man hours worked on the night trick is just as low or lower than on the 7 to 3 trick.

No Printed Rules

On our railroad we do not have printed safety rules. Without entering into any discussion as to the advantages and disadvantages of printed safety rules, I might say that I have been asked by supervisors from other railroads where safety rules were in effect, "How do you apply discipline for failure to observe safe practices?" The answer obviously is, we don't. However, when I first came to work on the Delaware & Hudson, 24 years ago, one of the first things I learned was, that a man was expected to do as he was told and when he refused to do as he was told, he automatically severed his connection with the company. That still holds true, and an employee must carry out the instructions of his superior, whether those instructions apply to accident prevention or other things in connection with his work. It is true that in rare instances, discipline has been applied by the proper officers for flagrant violations of safety instructions given by the foreman for the necessary protection of a man doing certain kinds of work. In such instances, discipline was administered not for failure to comply with safety rules but for failure to carry out the instructions of his foreman, or in other words, for insubordination.

It seems to me that it is ridiculous for us to assume that a man on our railroad, or any other railroad, gets hurt on purpose. He gets hurt because he or someone else has made a mistake and it is through an organized educational program that we must try to avoid these mistakes. The other day I heard a definition for education which appealed to me. "Education is anything which helps to reduce the cost of experience." It seemed to me that that is an especially appropriate definition for safety education.

The Problem of the Hundredth Man

A long time ago, one of our company surgeons told me that from his experience he had learned that you could get along with 99 out of every 100 men simply by being decent to them and by treating them fairly. The other one man out of the 100, he said, does not understand that kind of treatment and must be talked to in a language that he can understand.

With the average workman, it is not difficult for the foreman, by the use of tact and a friendly attitude, to impress upon him the importance of everybody pulling together to keep men from being injured. A supervisor has a limited number of men and by constant effort will soon have built up a group of men who will take pride in the good safety record of their department and will put forth considerable effort to maintain it. Perhaps this will not include every man under his supervision, but this safety group which he has built up will eventually take care of the others who have not as yet been convinced.

The next question which naturally arises is "What to do about the fellow who is difficult to reach by ordinary methods—this one man in a hundred who has to be talked to in a different language that he can understand?" This is a rather difficult question to answer because it is impossible to lay down a hard and fast rule as to the reaction of each individual under given circumstances. Each case of this kind, I believe, is a problem in itself, which requires study on the part of a supervisor who is personally familiar with the man. One of the things which we have found worth while is an arrangement whereby any safety committeeman, who feels that it will help him in his accident-prevention work to have some fellow employee sit in at one of the safety committee meetings as a visitor, can make either a written or verbal suggestion to the chairman that he be invited to attend the meeting. The chairman then notifies the man to be present at the next meeting. When he gets into the meeting he is not "bawled" out nor belittled in any way, but the chairman explains to him that he has been invited to sit in as a visitor to find out what the safety committee does so that he may be able to assist the committee in their program of preventing accidents in his particular department. He is asked to offer any suggestions that might occur to him and frequently does so. Sometimes the man is appointed as a regular member of the committee and it is the usual experience, that once convinced, he boosts just as hard as he previously knocked.

We have also found that getting three or four other men in the department besides the foreman and safety committeeman—this safety group which the foreman had built up in his department—to broach the subject of accident prevention tactfully whenever the opportunity offers will very often help to convince the fellow who is inclined to be a little stubborn.

Of course, we do have the fellow who it seems practically impossible to convince by any of these methods. Sometimes it is necessary for the foreman to say to this man—"Bill, you are a dangerous man to have around—We have all tried to help you but you don't seem to be willing to go along with us—I am afraid you are going to injure seriously yourself or someone else in the department and I have come to the conclusion that I can no longer assume the responsibility for your actions. You ring out and go in and see the general foreman." The general foreman talks to the man and sometimes takes him in to the division officer in charge at that point, who discusses the situation with the man and his foreman and in a day or two, the man is usually back on his job with an entirely different attitude, receiving very little sympathy from the other men in his department who feel that he deserved whatever he received.

The Goggles Problem

Perhaps another thing which causes difficulty in our accident prevention program is the fact that sometimes

supervision and safety officers are so thoroughly convinced in their own minds that certain safety devices are necessary that they fail to build the necessary foundation before issuing a mandatory order. To illustrate: Most of the officers and supervision on our railroad are thoroughly sold on the idea of eye protection, and in practically every car shop on the railroad, it is mandatory for employees to wear goggles at all times while on duty, with a certain few exceptions such as upholsterers and painters who do not work at places where there is an eye hazard. This was not accomplished without many months of preliminary educational work on the part of supervision, members of safety committees and others interested. This preliminary work was necessary in order to get the majority of the workmen in the same frame of mind as those mentioned, namely, that the use of goggles at all times was a necessary precaution, not only for the man who might be cutting rivets or chipping metal but for every other man working in or passing through a shop where such operations are performed.

We recently had a piece-work inspector who was saved the loss of an eye or at least a serious eye injury while checking a car in one of our larger shops when a shim which was being driven in a door bar ratchet by a car repairer flew and struck the lens of his goggles. To give you another illustration, an appurtenance inspector in an enginehouse went up on top of a locomotive to oil and inspect a bell ringer. When making this inspection, he gave the bell a turn while his face was still quite close to the bell ringer. Something scraped across his goggle lens and cut a gash an inch and a half long on his face below the goggles. Investigation developed that one strand of a double-strand wire, fastened to the bell for the purpose of ringing the bell by hand, had broken and was sticking out unnoticed by the inspector. The wire made a deep scratch across the lens of the goggle and this inspector told me that he was sure that, had he not been wearing his goggles, despite the fact that at the time there seemed to be no apparent eye hazard involved, he would have sustained a very serious eye injury.

Don't Fall Off

I do not recall who first said "Safety Promotion work is like riding a bicycle, stop peddling and you fall off," but it is a thought which might well be kept in mind. It is not what you did yesterday or the day before, or last week, or last year but what you do today, tomorrow and next week, and next year which will decide the success of your accident-prevention program.

Open Forum Session

Hot journals, long runs, tapered bolts and low stocks among the subjects of interest

The entire three-hour session on Wednesday morning was devoted to an open forum during which the discussion centered around questions which had been submitted by the members. The first question had to do with the methods used on different roads for combating the problem of hot engine truck and trailer truck boxes. The replies from several members indicated that the adoption of floating hub liners has been an important factor in the reduction of hot journals. Another beneficial practice brought out is that of relieving the crown brasses above the center line of the axle. The proper adjustment of shoes and wedges has an important influence. One road reported that it had had considerably less hot box trouble on engine trucks as a result of the adoption of a coil-spring engine truck design. The dicussion of the proper methods of locating grease grooves brought out the information, from another road, that it had eliminated grease grooves entirely in order to get as much bearing area as possible.

The second question brought up was "Does it pay to strive for high mileages between shopping?" and "Do long engine runs pay?" The consensus of opinion on both of these questions was in the affirmative. One road, reporting 300,000 miles between shoppings for general repairs, on a certain class of power, indicated that maintenance forces will do a better job on "long-run" locomotives than on those assigned to shorter runs with the result that greater mileage is obtained between shoppings.

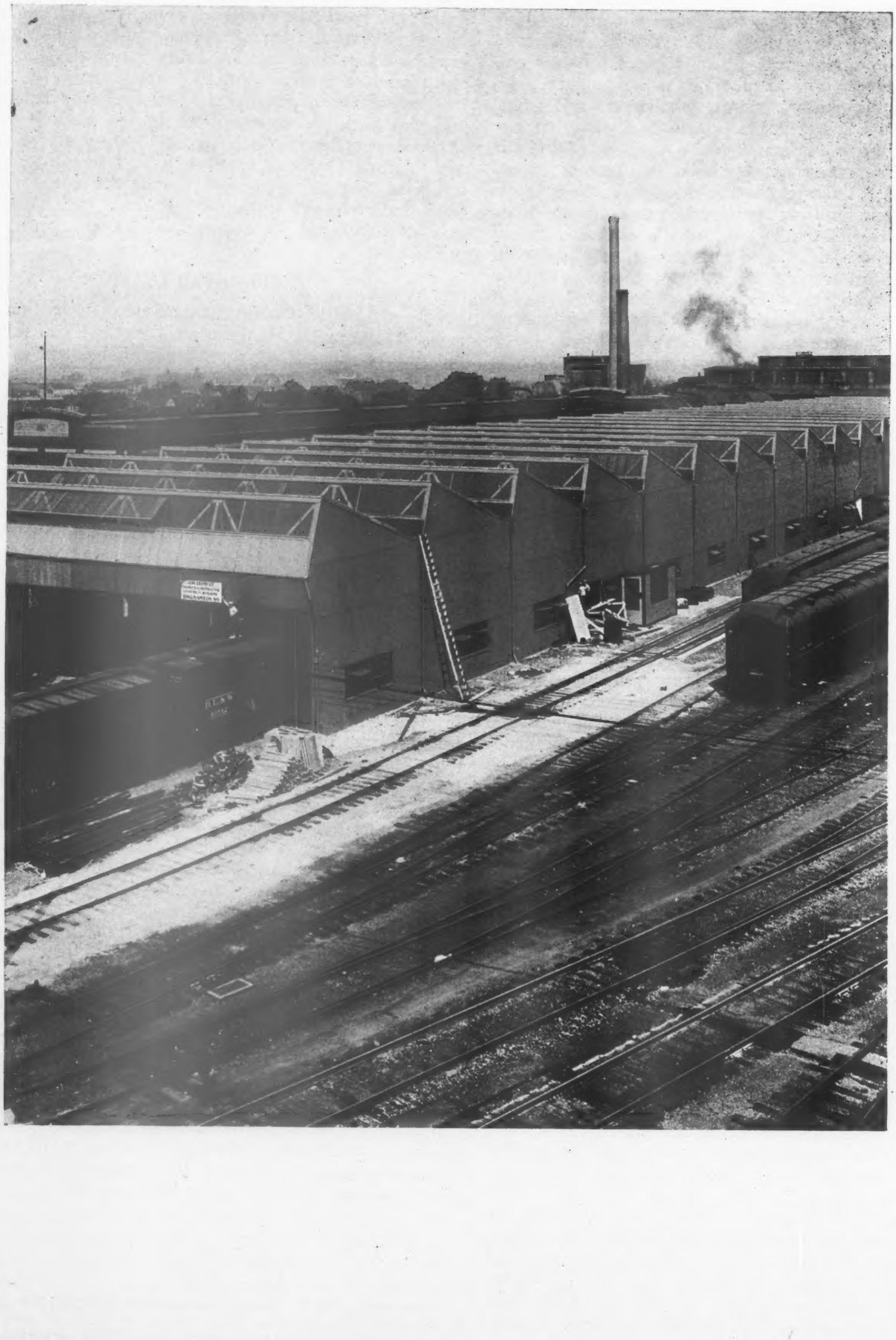
A discussion of a question as to whether any road had found a better material than bronze for shoe and wedge work brought forth no definite conclusions except that careful maintenance was necessary where bronze is used.

Another question brought out discussion on the subject of the best methods for the production of tapered bolts. Many roads, it seems, are now using the practice of producing bolts, on order, to gage sizes. This practice does, however, require that more care be given to the reaming of holes and several speakers told of the methods used to assure accuracy in this work.

A brief discussion of taper fits in driving wheel hubs brought out the fact that the practice of some roads of turning from one to two inches of taper on the ends of axles for convenience in mounting and quartering work had led some inspectors to believe that wheels might be loose. The question of loose wheels then entered the discussion and out of it came the comment, from several members, that many cases of loose wheels are the result of varying tolerances in fitting and that inconsistency in the lubricant used at the mounting press is another important factor.

The concluding question of the forum "Does it pay to maintain stocks at present low levels?" brought forth several comments from members which indicated that maintenance forces are seriously handicapped by shortages of material needed for emergency work. Two representatives of large roads, one a general enginehouse foreman and the other a shop superintendent, came to the defense of the stores department and concluded the discussion by saying that the stores department can only function as well as the mechanical department lets it by keeping it intelligently informed of future needs and that "most storekeepers will stock what you want if you know what you want and will use it after you get it."

Gardeners.—H. E. Frank, roadmaster's clerk for the Norfolk & Western at Chillicothe, Ohio, claims to have the only night-blooming cereus owned by a railroader. This rare plant is 40 years old, blooms three or four times a year, with 10 to 40 blossoms each time. Lafe Compton, retired conductor for the N. & W. at Kenova, W. Va., also claims the tomato-growing championship among railroaders. His vine, 14 ft. 8 in. high, bore 22 lb. of tomatoes, the largest 2 lb. 7 oz., last year.



Activities of

Car Department Officers' Resumed

Two-day convention held at Chicago was well attended—A future program of mutually helpful work is promised by an enthusiastic membership

After a lapse of seven years the Car Department Officers' Association met in convention at the Hotel Sherman, Chicago, on September 28-29, with a registered attendance of over 250. Except for the discussion of the A.A.R. Rules of Interchange, the program was made up entirely of addresses and papers. A considerable portion of the first session was devoted to business of the association, including the adoption of a new constitution and new by-laws. While the constitution and by-laws were adopted as a whole, they are based on the former laws of the association, revised to meet the changed conditions under which the association will function and the reorganizing necessary because of the long lapse in association activity.

The meeting was called to order by the president, K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, and the invocation was delivered by B. F. Jamison (Sou.), a member of the Association. Following the presidential address and that of Roy V. Wright, editor of *Railway Mechanical Engineer,* reports of the Auditing and Membership Committees and of the acting secretary-treasurer were presented and accepted. The Auditing Committee presented a report covering the period since the last meeting up to July 31, 1937, showing a deficit of nearly $300. Up to the time of the convention a total membership of about 550 was reported. The secretary-treasurer for the period August 1 to September 27, inclusive, reported a substantial balance on hand at the end of the period but pointed out that it would be insufficient to print the proceedings without receipt of additional membership dues.

During the course of the convention brief addresses were made by V. R. Hawthorne, secretary of the Mechanical Division, Association of American Railroads, and L. B. Rhodes (Vapor Car Heating Co.), vice-president of the Allied Railway Supply Association, Inc.*

The Election of Officers

Under the constitution adopted at this meeting the management of the association's affairs is placed in the hands of a board of directors consisting of a president, four vice-presidents, a secretary-treasurer and fourteen members representing railroad companies, two representing private car companies and two representing railway supply companies. The candidates for these offices are proposed by a nominating committee appointed by the president. The Nominating Committee proposed the following candidates who were unanimously elected: President, K. F. Nystrom, superintendent car department, C.M.St.P.&P.; first vice-president, E. J. Robertson, superintendent car department, M.St.P.&S.S.M.; second vice-president, C. J. Nelson, superintendent of interchange, Chicago Car Interchange Bureau; third vice-president, W. E. Dunham, general superintendent car department, C.&N.W.; fourth vice-president, J. S. Acworth, supervisor of equipment, General American Transportation Corporation; and secretary-treasurer, F. L. Kartheiser, chief clerk, mechanical dept., C. B. & Q.

The board of directors consists of H. H. Urbach, mechanical assistant to executive vice-president, C.B. &Q.; C. Claudy, master car builder, G.T.W.; P. P. Barthelemy, assistant master car builder, G.N.; S. O. Taylor, master car builder, M.P.; G. C. Christy, superintendent car department, I.C.; H. H. Golden, superintendent A.A.R. interchange and accounting, L.&N.; G. E. McCoy, assistant general superintendent motive power and equipment, C.N.; E. M. Wilcox, superintendent of equipment, N.Y.C.; J. E. Keegan, chief car inspector, Penna.; C. E. Strain, superintendent car department, P.M.; John Gogerty, assistant superintendent motive power and machinery, U.P.; J. P. Morris, chief mechanical engineer, A.T.&S.F.; O. F. Davisson, superintendent, Armour Car Lines; J. J. Root, Jr., assistant to vice-president, Union Tank Car Company; J. W. Fogg, vice-president, MacLean-Fogg Lock Nut Company, and L. H. Gillick, assistant to vice-president, Vapor Car Heating Company. The election of officers was held at the morning session September 28.

President Nystrom's Address

A six-point program to assist supervisors in meeting their responsibilities

The Car Department Officers Association held its last Convention August 26, 27 and 28, 1930, at Detroit, Michigan. Seven years have come and gone and no convention has been held because of the world-wide depression and to comply with the wishes of the Association of American Railroads, Mechanical Division, to curtail expenses which a convention would necessitate. The Association of American Railroads has kept a watchful eye on economic conditions and as an improvement has taken place it held a convention at Atlantic

* A paper, "Application of High-Tensile Steels in Car Construction," by A. F. Stuebing, United States Steel Corporation, presented at this meeting, will be published in a later issue.

City this year. The Car Department Officers Association, in common with other Mechanical Associations, was advised that a convention held this fall would have the full moral support of the Association of American Railroads as well as the support of executives of individual railroads.

No organization can remain practically dormant for seven years without a demoralizing effect. Our membership was approximately 2,000 in 1930. Since there was no practical means of holding the membership during the intervening years, no effort was made to do so. In the meantime, the railroads of this continent have undergone many changes. Some of our old staunch members have passed away, while others have retired. Therefore, after very serious deliberation, the officers and board of directors of the Car Department Officers Association have decided to start anew.

With the foregoing explanation, I offer no apology for the program of this convention. The program lacks individual papers on important car-department issues. Obviously, our various committees could not be efficiently restored in the short space of time available to prepare the usual reports. The officers and board of directors felt that old and new members would be better served if a program would consist of addresses which would develop the duties of car-department officers.

At this session, revised by-laws will be submitted which will better serve to cover the functions of our organization. However, by-laws are secondary to the purposes of a live association and I will attempt to outline briefly the purposes of our Association.

Friendliness and Loyalty

The aim of this organization is to have its membership extend from Maine to California, from the northern part of Canada to the most southerly point in Mexico—in other words, to cover this continent. Notwithstanding the immense extent of this territory, we propose to provide a means of getting together at such intervals as the Association of American Railroads may indicate in the future.

We all know from personal experience that we can accomplish our duties more efficiently and with greater ease if we have a personal acquaintance with the men involved on other railroads. Such acquaintance is accomplished through an organization such as ours. There is, to my knowledge, no group of employees as interwoven as car-department employees on this continent. A car-department supervisor employed on the Atlantic coast will take care of and be responsible for a car owned by a railroad on the Pacific coast or vice-versa.

The loyalty of car-department employees is very outstanding. A layman will hardly appreciate a car-department supervisor's loyalty in handling the cars allocated to his inspection or supervision. His ambition to cover and protect the standard of his cars becomes a matter of personal pride and interest, so that, particularly at interchange points, he refers to "my cars." Friendly understanding with member roads and loyalty to the property he serves will be one of the aims of the association.

Interchange of Equipment

In 1867 the Master Car Builders' Association was formed for the object of expediting the movement of cars of various ownerships in interchange. During the intervening seventy years a code of interchange rules has been developed, also rules covering the loading of various commodities. The interchange of equipment throws an added responsibility on the car-department supervisor which is unique and has no parallel in the world. The Code of Interchange Rules, to a car-department employee, is a very sacred document. It involves the necessary repairs and care of any and all cars, regardless of ownership, while in his care.

The bills for repairs to freight-train cars while off line amount to approximately $27,000,000, or 15 per cent of the total cost of repairs to freight-train cars. As the annual repairs to passenger- and freight-train cars on this continent probably amounts to $250,000,000, it is not difficult to visualize the responsibility of the car department. This vast interchange, as we know, is controlled by the Association of American Railroads, which has absolute authority to settle all disputes, amend the rules, and define improvements in equipment. Settlement of disputes by the Association is recognized as final by the courts of law. All this is as it should be, and we, as an association, honor, respect and co-operate with the Association of American Railroads.

Repair Problems

The ownership of cars fluctuates but there are approximately 41,000 passenger-train cars on this continent. The maintenance of passenger-train cars, particularly with the introduction of air-conditioning equipment, high speed, new types of brakes, ever increasing improvements in interior appointments, and persistent demand on sanitation and cleanliness, has in the last few years virtually doubled. Many complicated problems have arisen and the exchange of ideas is a necessity for an economical maintenance operation.

Out of approximately 2,200,000 interchange freight-train cars, railroad and privately owned, in existence on this continent, there are several hundred types of cars and designs, all of which may appear on the railroad you are serving. To give prompt, economical and efficient repairs to cars of foreign ownership is one of the duties of a car-department supervisor and is a perpetual problem common to all of us. This organization will have an open forum at all conventions where problems under this scope will be discussed. Improved facilities and greater efficiency for current repairs on the average repair track and an economical and systematic general repair program in shops are of very vital interest to all car owners.

In the last few years, railroads have been forced to make radical changes in car design. In the meantime, high speed has been introduced requiring different equipment than in the past, both as to weight and other factors. Electric welding has been introduced to a very large extent. Some railroads have begun to build their own equipment and this probably will be extended. Therefore, a comparison of designs, shop facilities and shop methods will be given consideration by this association.

Back-Door Salesmen

Another duty of the car-department officer is to repair and prepare freight cars for various kinds of commodity loading. This requires a minute knowledge of requirements of shippers and I commence to believe that if the car-department on a railroad will measure up to its fullest responsibility, the car-department officers can do more to promote an increase in business on American railroads than any other railroad employee.

In this modern age, we have two types of salesmen—the regular salesman who has entrance through the front door, and another type of salesman known as the back-door salesman. A car-department employee is a back-door salesman. He does not make a sales talk or traffic talk, but comes quietly to the back door—the shipping platform—and inquires if the equipment is satisfactory,

and what he can do to better the service, etc. Recently, at a certain point a railroad had for several years lost the good will of a shipper and, with it, the business. A suggestion was made that the local traffic man, together with the car foreman, pay a visit to the concern and see what could be done. The traffic man advised that, if any soliciting was necessary, he was competent to handle it. But no effort on the traffic man's part was effective; then the car foreman was asked to approach the shipper. He did not go to the front door, but went to the back door and carefully inquired what the requirements in the way of equipment were and asked for a chance to furnish one car, which was given him. The result was that the business was regained one hundred per cent. To be an efficient rear-door salesman requires tact and experience.

An organization like ours would be incomplete if Safety First and the welfare of fellow workers were not jealously safeguarded. Therefore we will stand always for safety and with every available agency promote Safety First.

In conclusion, the Car Department Officers' Association pledges itself to create friendship and better understanding among member roads, to further improved and simplified interchange in complete co-ordination with the Association of American Railroads, study for better and more economical maintenance of passenger- and freight-train cars in daily operation, improve shop practices for repairing cars and the building of new equipment, further promote better selection of equipment for commodity loading and foster the safety and welfare of the large railroad transportation family.

Why a Car Department Officers' Association?

Possibilities of such an organization are very great, if correctly appraised

By Roy V. Wright

Editor, Railway Mechanical Engineer

A well-known member of the Mechanical Division of the Association of American Railroads recently remarked in private that he could see no good reason for the Car Department Officers' Association. He indicated that the Mechanical Division was quite capable of handling the standards and recommended practices relating to the car department, and that it received sufficient help from the local car interchange inspectors' associations and clubs in making its periodical revisions of the interchange rules.

Even assuming the correctness of his statement—and I am not willing to grant it—there still remains a large, one might even say vast area, which is uncovered, the constructive study and treatment of which is quite vital if the car department is to meet successfully the heavy demands which are being made upon it. Here is a department which expends large sums of money on the construction, maintenance and repair of the equipment in its charge. Is its supervisory personnel so well trained and so able that it can get along without those processes which seemingly are essential to all sorts of highly specialized groups in collectively studying tendencies in their fields and in organizing to develop methods which will more effectively meet new and changing conditions?

What has the Mechanical Division to offer, or what has it done to solve the great number of difficult and baffling problems concerned with the operation and management of car repair shops and yards? Where in its records will you find anything about the tools and the facilities required for car construction, repair and maintenance? Where will you look for information or suggestions about the numerous major problems concerned with shop methods? Or how about methods of selecting and training employees, or training the supervision? And yet, the way in which these problems are tackled and handled means a great deal on a dollar-and-cents basis, as to the unit costs of performing the work. Moreover, when we realize the large percentage of the budget which goes to labor casts we cannot fail to recognize the potential savings which may be made available through up-to-date methods of supervision and administration.

Radical changes have been taking place in railroad freight and passenger traffic and in the car department, and this is all the more reason why its leaders must be continually on the alert and must pool their ideas and energies, in order to capitalize to a maximum extent on these tendencies and upon the improvements which are being made.

Car Department Not Static

It seems almost superfluous, in a group of this sort, and yet it may be well briefly to review a few of the high spots in the developments of the past decade and a half. In the freight traffic department we can all recall the paralyzing congestions which occurred more or less periodically with the fluctuations in business prior to 1923. Challenged by this shortcoming, which brought severe criticism upon railroad managements and which, in the opinion of some at least, threatened to bring about government ownership, if not corrected, the American Railway Association, as it was then designated, inaugurated a campaign with certain clearly defined goals for the betterment of the services. This was participated in enthusiastically by the railroads as a whole and brought about surprising and gratifying results.

It resulted, for instance, in better loading of freight cars, higher freight-train speeds with long, continuous runs, and prompt deliveries. Freight trains moved with the same reliability, and in many instances, with almost as high a speed as passenger trains. These efforts clearly focused attention upon maintaining the equipment in such condition that cars would not break down on the road or require setting out at division points for the transfer of loads. It emphasized, as nothing else could, the need of first-class equipment with high standards of care and maintenance—a new conception for which car department officers had been devoutly praying for a long time. Hit-and-miss repair methods with mediocre maintenance and repair facilities, and inadequately trained forces, could not stand up under the pressure, and the place of the car department in economical and efficient operation was considerably enhanced.

Still Another Challenge

The depression naturally slowed up the progress

which was being made in improving the equipment and the organizations in charge of its care and maintenance. On the other hand, certain factors developed in these difficult years which have tended to place still greater emphasis on their importance. Threatened with continued inroads of the highway carriers upon freight traffic, the railroads were driven to devise ways and means of regaining their lost prestige. Better service had to be given and this required still higher standards of physical condition for the equipment, not only that it might travel faster and with greater reliability, but that the damage to the lading caused by defective cars might be reduced to a minimum. Moreover, this high standard of equipment and its maintenance must be furnished at low cost, for legislation and regulation have tended to increase the expenses of operation, and subsidized competition has cut into railroad revenues to a point where there have been little or no net earnings and it has been difficult to secure capital for improvements. This has made it all the more necessary to reduce the costs of maintenance to the lowest possible point, although this, as you know, is nothing new to those who have carried on the responsibilities of the car department administration from its earliest days.

The campaign which was started in 1923 focused attention upon the necessity of providing better repair and maintenance facilities and tools; it stimulated the further development of carefully devised rebuilding and retirement programs, with a view to performing the work in the most efficient and effective manner and eliminating obsolete equipment. It forced into the foreground the need for greater attention to the working personnel and to better supervision. It is sincerely to be regretted that the depression caused a slowing up in these processes. Apprentice training, for instance, where it has been carried on in an efficient way, was practically thrown overboard, except in a very few places.

Here, then, are a number of pressing problems in the department of freight car maintenance which require study and attention, and concerning which the car department officers, collectively, can give a splendid account of themselves if they will co-operate in a statesmanlike approach, through an association of this sort. Summarizing, studies and reports could well be made on the proper selection and training of recruits; of ways and means of improving the efficiency of the supervision; of training and coaching the men now in the service in order that they may hold their own in adapting themselves to new practices and equipment; of the best types of facilities and methods of performing the various classes of work, and of the proper tools to use. These are only a few suggestions of the many vital and practical problems which demand attention; you can readily think of others. New materials and new methods of construction coming into use tend further to intensify the problem.

Obvious Weak Spots

Then, too, no one can gainsay the fact that there are still too many breakdowns on the road and too much damage to equipment and lading, because of the defective condition of the cars, whether it is caused by poor construction or under-maintenance. There is also a large question as to whether the railroads can withstand destructive competition if they must continue to insist upon the unreasonably severe packaging requirements which are demanded by no other type of transportation. Poor condition of equipment, as well as rough handling and gross carelessness on the part of the employees are responsible for this damage. The freight car maintenance department cannot evade its share of the responsibility, and it is a serious one.

Passenger Car Maintenance

The responsibilities of car department officers have increased equally as much in the field of passenger car maintenance as they have in that of freight cars. Stop for a moment and consider what has taken place in passenger traffic in recent years. The private automobile, the motor bus and the airplane have played havoc with railroad passenger traffic.

The situation became desperate, indeed, and yet, fortunately, the tide was turned in the very heart of the depression. Air conditioning, which was started in a small way, spread quickly, even though it was rather crude in some of its early applications. Then came the announcement of the high-speed, streamlined trains. These quickly captured the public imagination and incidentally resulted in the speeding up of passenger services generally. They also jolted the passenger traffic departments and stimulated their imaginations to develop more effective measures for securing new business. It is not surprising, therefore, that the car department is now being called upon not only for new equipment, but for extensive rebuilding and modernization of the older passenger train cars. Great ingenuity is being shown in such modernizing programs, which include the addition of many conveniences and all sorts of gadgets, including better and more scientific lighting.

Higher Standards of Maintenance Demanded

Higher train speeds call for a better type of maintenance, for more critical inspections and for greater attention to many details which are concerned with insuring safe operation. Air conditioning makes possible the maintenance of much cleaner interiors and this in turn has stimulated the introduction of more artistic, comfortable and convenient furnishings and equipment. Like the dog chasing his tail, this has made necessary still higher standards for cleaning the equipment. Always difficult problems, those of cleaning and inspecting the passenger train cars now assume even larger proportions. Is it not an important function of your association to devote much time and energy in striving to determine the best ways and means of maintaining passenger equipment in the very pink of condition, in order to strengthen the railroads in their battle to retain and build up passenger revenues?

Here again, also, are involved the problems of building up and maintaining an ample staff of skilled workers for the inspection, maintenance and repair of the equipment; of discovering and adhering to the best practices in the management of these forces; and of providing and properly arranging the facilities and tools, in order to perform the necessary operations most efficiently. This is no simple or easy task when one considers the changes which are being made in the design and construction of the new equipment and of new specialties which are being added in the interests of faster, safer and more comfortable travel.

The Net Result

As a net result of all these things, the car department faces larger and growing responsibilities. The demands are far more exacting than even a few years ago. Rising costs and keener competition from other forms of transportation make vital higher standards of maintenance and more efficient operation. Many car department officers can point with pride to improved facilities, to the more extended use of welding, for instance; to well-devised schedules of rebuilding and repairing cars, the introduction of straight line methods, etc. On the other hand, much is still to be desired on the part of even those who lead in these respects.

Pooling of ideas and interchange of experiences among department specialists have proved invaluable in the growth and development of American railroads. Study and critical analysis of all of the details concerned with the operation of the car department are vital. Certainly these matters are not now matters of study or concern on the part of the Mechanical Division. Moreover, a review of the transactions of the Car Department Officers' Association or its predecessors before the depression years indicates that it can perform this function to excellent advantage.

Interchange Rules

I have made some reference to the interchange rules. With changes in design, construction and operation of freight cars, these rules are naturally subject to occasional revision. Ordinarily, suggestions for such changes originate with the men on the firing line and are first discussed and recommended by local associations of interchange inspectors and car foremen. They are then passed on to the Arbitration Committee of the Mechanical Division, a committee which, by the way, has always discharged its responsibilities in an exceptionally thorough manner, and which, to a large degree, is responsible for the splendid results obtained from the interchange rules.

Ever since the formation of this association it has been the practice to give a prominent place on its programs to a consideration of possible revisions in the interchange rules, and this would appear to be a wise provision, since the association is made up of the various elements vitally interested in the application of these rules, and represents a national, rather than a local viewpoint. It would seem that it could be of invaluable assistance to the Arbitration Committee in acting as a double check by men of broad experience, in studying and discussing suggested changes before they reach the Arbitration Committee. This is the more important because these rules are now refined to such a great degree that every precaution must be taken to examine thoroughly and most critically any changes which may be suggested.

But there is still another aspect in which this association can be of assistance in connection with the interchange rules. After changes in the rules have been adopted by the Mechanical Division, it is of extreme importance that steps be taken to insure that they are uniformly interpreted. Here the Car Department Officers' Association can render a substantial service, since it can give the changes adopted at the previous meeting of the Mechanical Division more or less careful study prior to its annual meeting, and arrange for a thorough discussion at that meeting as to how they should be applied and interpreted. This function, which has always been a part of the work of this association and its predecessor, the Chief Interchange Car Inspectors' and Car Foremen's Association, can continue to prevent disputes and thus keep down the docket of the Arbitration Committee, just as it has been doing for the past 40 years.

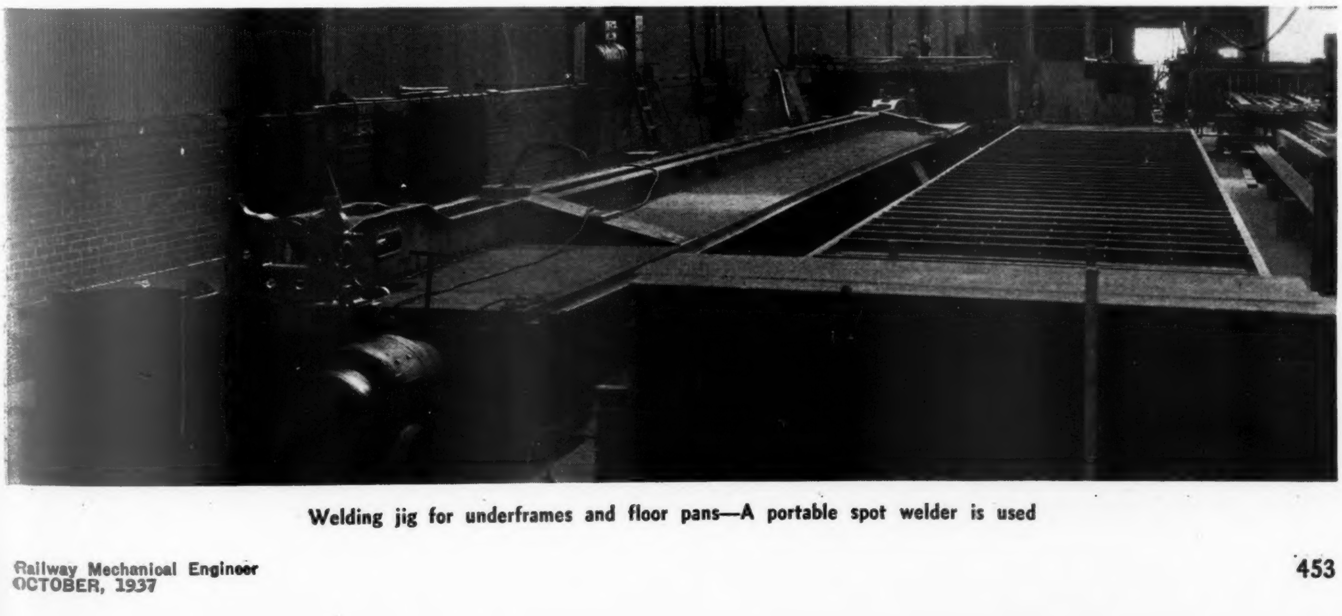
Consolidation of Associations

There has been much talk about the consolidation of the various so-called minor mechanical associations, and certain steps have already been taken in that direction. While this may possibly safely be done to a limited extent, most of the associations are so highly specialized that it is not wise to consider actual consolidation. It is true, on the other hand, that some of the associations now overlap to a certain extent, or, at least, there are common problems in which they may be mutually interested. If this year's practice is continued and several of the associations meet at the same time, with a common exhibit, then it would seem that arrangements could very well be made to provide in some instances for joint sessions on topics of mutual interest to more than one of the groups. Comparing the programs of the associations meeting this week, it is obvious that joint study could wisely be given to eliminating certain overlaps, either by restriction as to the subjects to be covered by each association, or by provision for joint sessions.

Large Place for the Association

There is a large place for the Car Department Officers' Association. This was clearly demonstrated prior to the depression years. Conditions during the past few years have played havoc with all of the associations and some of them have been severely crippled, if not almost entirely dissipated. Railroad officers who must sit in judgment on whether or not their subordinates should affiliate themselves with the various associations, must base their opinions on the type of programs which are submitted and upon the practical results achieved. Those associations which have a real function to perform will survive, if they have the courage, the imagination and the will to press forward with vigor and confidence.

* * *



Welding jig for underframes and floor pans—A portable spot welder is used

Relation of Car Department to Safe Train Operation

Improvements in car design and equipment which merit the support of car-department officials

By W. J. Patterson

Director, Bureau of Safety, Interstate Commerce Commission

Mechanical matters require constant consideration to provide for constantly changing operating conditions in order that the safety of employees, travelers and property in transit may be adequately maintained. The Car Department Officers' Association is well equipped to initiate and develop improvements of a mechanical nature, including necessary rules and regulations, and see to it that such improved devices, together with the rules, are utilized and observed.

Personal injuries and property damages are not only direct losses that dissipate earnings but they also tend to divert business and to affect the morale of employees. Safety is greatly desired by the extensive personnel who operate the railroads because it is a personal matter with railroad employees to avoid injury to themselves, relatives, friends and co-workers. To the general public which depends upon and pays the railroads for personal and property transportation, efficient, dependable service with safety is of first importance.

An active interest in safety of railroad operation has also been definitely manifested by the Federal Government. By acts of Congress certain powers have been vested in the Interstate Commerce Commission, and the Bureau of Safety was created to administer laws enacted for the purpose of promoting safety to persons and property. There is, therefore, no apparent opposition to the cause of safety in railroad operation but rather a combined effort to promote and improve it. The greatest possible co-ordination of all the forces that are at work to promote safety is the prime objective for which we are striving.

The actual movement of traffic on railroads involves three major departments: (1) Roadway, including signal system; (2) mechanical and (3) operating. Other general departments in the total organization of a railroad, such as traffic, accounting, etc., are not so directly involved in the physical movement of traffic. Each of the three branches named has a distinct responsibility in the safe and efficient operation of a railroad.

At this meeting of Car Department officials, I shall confine my discussion to some of the problems of the mechanical department, more particularly the car department. In considering and working upon these problems, there has been a high degree of co-operation between the Bureau of Safety and the Association of American Railroads and as a result of this co-operative effort important results have been accomplished.

Car department officials are responsible to the general administrative heads of their companies for the safety of their employees and for providing and maintaining equipment in safe condition to transport commerce moving over their lines. Serious thought and action have been devoted by car-department officials to safeguard employees on duty; this fact is clearly evidenced by the safety-first organizations of most carriers and the excellent results obtained by such organized efforts. And the efforts of car-department officials to improve the safety and efficiency of equipment is reflected in the highly organized Mechanical Division of the Association of American Railroads. Committees of the ablest practical engineers on car construction are constantly at work investigating and testing materials, designs and methods of construction and revising specifications for various elements in car construction with a view to greater safety, economy and efficiency, including trucks, wheels, couplers, draft-gears, air brakes, hand brakes, etc. Such work is ordinarily done in collaboration with the best engineering talent of the manufacturing companies, and the final results should, and generally do, represent the most advanced thought and practice of the time. Within recent years practically all of the main features of car construction have been revised and improved to such an extent that increased train speeds have been made possible and it is probable that these improvements have provided factors of increased safety which have offset the hazards introduced by higher speeds.

Evolution in car construction to improve both safety and efficiency is continually in progress. Improvements of this character when thoroughly proved and adopted should be put into effect as rapidly as possible, or at least within the very liberal periods specified by the Association of American Railroads for the change. Unfortunately this has not occurred in some of the major improvements. In case of the elimination of arch-bar trucks, initiation of a definite program to change to cast steel trucks was delayed by many carriers, apparently little if any effort being made to effect the change within the time specified even after it was clearly established that trucks of this type were not safe for increased loads and higher speeds. Because of these dilatory tactics various extensions of time were granted, but even yet the necessary rate of progress to effect the required change within the present time limit has not been developed by a few carriers and private car lines. Because of the dangers of indiscriminate interchange of cars equipped with arch-bar trucks and the losses sustained by handling carriers, any further extension beyond January 1, 1938, is not justified and has been refused. It is quite probable that some car owners who are not operating carriers may claim that the rule is discriminatory against them because their cars with arch-bar trucks will not be accepted after January 1, 1938, by operating carriers who have heretofore been not only accepting such cars but also assuming responsibility for results in operation even to the extent of reimbursing the owner of the car which, due to failure of an obsolete arch-bar truck, is not only itself destroyed but also causes the destruction of other cars, property and human life as well. It is hardly to be expected, however, that the great majority of operating carriers who have co-operated to eliminate this hazard to safe railroad operation will be required to retreat in their progress for greater safety and continue to accept and handle such cars belonging to a few car owners who have failed to co-operate in this program for increased safety of life and property.

The facts in the development of the standard A.A.R. couplers are well known to you. The reduction from over 100 makes to one standard design, which is safer, more efficient, and economical, was commendable, progressive action. It was brought about by the co-operative efforts of Car Department officials through their

organized channel for action, the Association of American Railroads, and the manufacturers. Unquestionably the results were greatly beneficial to railroad operation, not only as a factor of safety but economically as well.

The revision of wheel standards for greater safety in the last decade is also worthy of mention. The double-plate type of cast-iron wheels was replaced by the improved single-plate type and the specifications of foundry practice were sharply revised to comply with more modern methods and eliminate questionable practices. The application to foreign cars of cast wheels manufactured prior to January 1, 1921, has now been prohibited, thus closing a possible outlet for old wheels that may yet be within the limits of wear. It is to be expected that car-department officials will give very careful attention to the question of application of such old wheels to their own cars in present-day high-speed service.

The establishment of standard draft gear requirements marks an important step to meet a very pressing need for material improvement in this equipment; however, experience may demonstrate the need for revision of the standards which are now in effect, and while these standards will effect a material improvement in new construction the elimination of obsolete and inefficient draft gears on cars now in service presents a major problem for the car departments. Proper design and functioning qualities of draft gears are of vital importance in the safe operation of modern trains at increased speeds.

Maintenance of Draft Gears

Maintenance of draft gears, their attachments and supports, is a matter in which car-department officials are vitally interested and for which they are responsible. During the past three years a great deal has been said about free slack in draft gears. Regulations for "Inspection and maintenance of draft gears and attachments by car owners," submitted by a joint Subcommittee on Couplers and Draft Gears and the Arbitration Committee, was adopted as recommended practice in 1934 and is now shown in the A.A.R. Manual; in January, 1935, the Association of American Railroads requested all car owners to see that these rules are strictly enforced on their own cars in order to improve condition of couplers and draft gears by the elimination of slack in gears as far as possible. Satisfactory improvement was not accomplished under this recommended practice and in December, 1936, attention was again directed to the urgent necessity of complying with the instructions in order to carry out the intent of the recommended practice. Referring to this subject, the Committee on Couplers and Draft Gears, in its report this year, stated: "Your committee cannot urge too strongly the necessity for proper supervision of the repair points to insure that these instructions are being carried out in order to eliminate failures and possible accidents."

Progress has been made in effecting this improvement by a large number of car owners, but there are still many cars in service with draft-gear conditions that are a hazard to safe train operation. Several accidents have been investigated by the Bureau of Safety, which were caused by break-in-two of trains due to knuckles slipping over on account of low coupler, defective or insecure coupler supports and excessive free slack, permitting the coupler to stretch out an excessive distance on a hard pull, so that the coupling face could drop below or be raised above the prescribed limits of height. Regular train-yard inspections just prior to the movement involved in each case disclosed no exceptions.

A coupler not properly supported in a horizontal plane, and drooping downward at head, may cause a break-in-two at any time, and especially so when there are several inches of free slack in addition to the normal coupler travel due to gear compression. The numerous occurrences of slip-overs point to the fact that many couplers which are within the prescribed limits of height when inspected at rest are not supported so that they remain within those limits when stretched out on a hard pull. Bent and loose carrier irons found where excessive slack existed in draft gear also indicates that the excessive stretch-out of the couplers produces a destructive leverage on coupler supports developing bent or insecure carrier irons, causing low couplers and resulting in break-in-twos.

The need for more positive measures to take care of cars of owners who have not responded to present recommended practice is very evident. As an example, in a recent accident investigated by the Bureau of Safety two separate break-in-twos of the same train were found to have been caused by low couplers, bent carrier irons and excessive free slack in couplers. The two cars causing the first break-in-twos were sent to the handling line's nearest shop, where the carrier iron of one car was repaired and a shim applied on the other to adjust the coupler height. The shop foreman found 2¾ in. of free slack in one coupler and 2¼ in. in the other but did nothing about it. The cars which were owned by private lines proceeded on their way with this free slack condition not corrected. A third car, which caused the second break-in-two on the same trip, was inspected on arrival at the terminal and the low coupler was raised by application of two shims, and it also went forward on same date. This was also a private line car; it thereupon moved over six different carriers to its owner, a distance of 1,200 miles or more, with the two shims on the badly bent carrier iron. On arrival at home the car was shopped. The bent carrier iron was replaced but slack in draft gear was not examined or corrected and the car was released for service. It was held for inspection by request of the Bureau of Safety and found to have 2½ in. of free slack in the draft gear at each end of car.

It is evident that the present recommended practice, which merely requires attention to slack at times of air-brake attention by car owners only, will not eliminate many really bad cases of free slack in service. Therefore, it appears that more positive measures are required to deal with this condition. The suggestion has been made, and is here repeated, that serious consideration should be given by car-department officials to a thorough, periodic check of draft gears, their attachments and supports, to determine the coupler travel, free slack, etc., and assure that supports are ample and secure to maintain the coupler within the prescribed limits of height at extreme travel as well as when at rest. The importance of proper condition of draft gears and the possible results of break-in-twos fully warrants such a periodic check and appropriate marking on cars showing that such attention has been given, in a manner similar to inspection of air brakes and journal boxes.

Braking Equipment

Closely associated with the draft-gear question and slack action in train movements is the matter of air brakes. The hazards and destructive results of severe slack action in emergency brake applications have been demonstrated in several accidents investigated by the Bureau of Safety. In at least three such instances recently, the train was buckled, throwing cars out so as to foul a parallel adjacent track. In one instance the train buckled directly into the path of a train on an adjacent track, causing disastrous wreckage of both trains and loss of life. With all other features in good run-

ning condition, the safe speed of trains is largely dependent on adequate means of controlling speed.

The report by the Interstate Commerce Commission in 1924 upon the formal investigation of power brakes and appliances for operating power-brake systems set forth the urgent necessity for improved power brakes and for specifications and requirements covering their functions, maintenance and operation. Extensive research and tests by the Association of American Railroads, the air-brake manufacturers and the Commission led to the development and adoption by the Association of American Railroads of specifications for improved brake equipment which became effective September 1, 1933. Later an A.A.R. rule was adopted, effective January 1, 1935, requiring all freight cars in interchange to be equipped on or before January 1, 1945, with air brakes meeting these specifications, and further requiring each car owner to report progress quarterly to the Association of American Railroads; this information to be filed with the Interstate Commerce Commission.

In accordance with this rule, as of June 30, 1937, 202 railroads and 200 private car lines reported a total of 2,177,158 freight cars owned, of which 163,764, or 7.52 per cent, were equipped with power brakes conforming to the specifications. Thus in 2½ years, or 25 per cent of the total 10-year period alloted for this improvement, we find only 7.52 per cent of cars are so equipped.

The urgent need for the improved air brakes with more rapid serial action is stressed by several recent accidents caused by trains parting and the resulting emergency brake applications. The records show that some car owners have made progress in accordance with the schedule requirements and several have made some progress, but the greater number of car owners do not as yet have any cars so equipped. It is apparent that this important improvement for safety of train operation is not progressing as scheduled. Car owners who are wilfully delaying action on this important improvement for safety may find difficulty in obtaining liberal extensions such as were granted in case of arch-bar trucks. Aggressive action to carry this program through as scheduled is strongly urged.

It is apparent that in recent years, while freight train speeds have materially increased, the effective braking power of many freight cars under load has materially decreased. This was largely caused by the increase of the ratio of load to empty car weight, due to lighter weight in construction made possible by improved materials and methods of construction. The trend of construction to reduce light weight has resulted in many thousands of cars being placed in service with an effective braking power of only 12 to 15 per cent of the gross load on rail, which is not adequate to control trains properly under all conditions. Continued efforts have resulted in the adoption of revised braking ratios on new freight cars of a minimum of 18 per cent and preferably 20 per cent of gross load on rail. Where this cannot be obtained at the permissible maximum of 75 per cent of the light weight of car, the empty and load brake must be used.

Within the last year it became necessary for the Bureau of Safety to stress the fact that a large percentage of hand brakes on passenger train cars were not efficient, due largely to improper maintenance and adjustment. Many were found on which the rods or levers fouled so that an effective application of the hand brake was impossible. Some were inefficient in design and power so that the brake shoes could not be brought into effective contact with wheels. Cooperative action with duly authorized committees led to the adoption at the recent A.A.R. convention of specifications for hand brakes on new passenger train cars and of a set of rules governing the inspection and maintenance of hand brakes on existing passenger train cars. These rules are comprehensive and if followed will provide efficient hand brakes as required by the Safety Appliance Acts. Ample opportunity having thus been provided to correct this condition, violation proceedings under the law should not become necessary in order to bring about compliance.

Conclusion

Improvement in railroad operation, that is, movement of traffic with greater dependability and safety at greater speed, has been and will continue to be the result of gradual evolution of equipment, appliances and practices which made such progress possible. Improvement in rolling stock is one of the important elements

Lightweight cars are made possible by improved materials and construction methods

involved in this progress. The officials of the car department are especially well organized through their various associations, and finally through the Mechanical Division of the Association of American Railroads, to initiate and bring about improvements to cars as they become necessary to meet the demands of traffic. In fact, such progressive action is the past history of the Mechanical Division of the Association of American Railroads and its parent organizations, the American Railway Association and the Master Car Builders Association. Such associations as this of yours are the background of action on rules, standards and practices that are adopted and made effective by action of the A.A.R. for all member lines. The A.A.R. committees on the important car-equipment subjects are generally headed by and composed of car-department officials qualified by knowledge and experience to conduct research work and tests, and to furnish comprehensive and constructive reports on their respective assignments. Car-department officials as a whole are more directly responsible for the rules, practices and standards, promulgated by the A.A.R., governing the condition of and repairs to freight and passenger cars in interchange, than any other group. It naturally follows that those most responsible for the adoption of certain requirements should be the most interested in carrying out those requirements. I urge, therefore, that all car-department officials give their greatest cooperation and support in carrying out the A.A.R. rules adopted in the matter of (1) Eliminating arch-bar trucks (2) equipping cars with improved air brakes by January 1, 1945; (3) revised braking ratios; (4) improved hand brakes on passenger cars, and (5) improvement of draft-gear conditions.

All of these are progressive improvements for greater safety in operation, and having stood the careful consideration and tests of duly constituted committees and then been adopted by the A.A.R., they merit the unqualified support of all car-department officials and member lines to keep the car department in its proper relation to safety and efficiency in all branches of railroad operation.

Car Men's Relation to Loss and Damage to Freight

Concrete suggestions as to car conditions needing correction

By W. L. Ennis

Manager, Refrigerator Service and Freight Claim Prevention, C. M. St. P. and P.

In glancing over the report of the Association of American Railroads, Freight Claim Division, covering loss and damage claims paid during the year 1936 as compared with 1935, we find that in 1936 the carriers spent $20,920,000 in Loss and Damage claims, as compared with $17,946,000 in 1935, an increase of very nearly three million dollars, or 16.8 per cent. Now here is where car men enter the picture. Of that amount the carriers in 1936 spend $1,208,000 in claims due to defective or unfit equipment. In 1935 they spent $925,-000. You will note there was an increase of $283,000 or 30.6 per cent, very nearly twice the percentage increase as in the general loss and damage bill.

Commodity prices have shown an upward trend for the past two or three years, and it is possible that that upward trend has not stopped, making it doubly necessary for us to take whatever action is necessary to stop that increase, and if possible reduce it.

The amount of money that the railroads spend each year in loss and damage claims is nothing more than a waste, does no one any good and the money could be spent for much more useful purposes, such as improving our property and equipment. However, aside from the monetary issue, we have a much greater item to consider, and one that every employee on the railroad is vitally interested in, because it means his bread and butter. That is the dissatisfaction that is created where we damage or delay freight, and you can rest assured that, if we continue to damage and delay freight, our shippers are going to be dissatisfied with our service and are going to find some other means to transport their freight where it will receive better attention. Naturally the railroads losing business must decrease their expenses. Often the quickest way to get money is to reduce payrolls, and that means taking off employees. Therefore, every employee should be interested in reducing the loss and damage bill.

Classifying Cars for Commodity Loading

The car man is responsible for the classifying of cars for commodity loading. The transportation department depends entirely on the carding on the car, and where the inspector does not give sufficient time and thought in the inspection before carding a car, failing to develop whether it contains any protruding nails, bolts, etc., whether there are rough floor boards, side sheathing and other defects in the floor, roof or sides, liable to cause damage to freight in the way of contamination, he immediately creates a situation that will eventually lead to claim payment. Classifying cars for commodity loading should be confined to the daylight period. If it is not trouble is bound to result, not only in the way of damage to freight but worse yet in the way of a dissatisfied patron, not to speak of the additional expense incident to handling and switching an unfit car in and out of an industry, team track or warehouse.

The Western carriers for the past few months have been handling a large grain crop, and have had considerable difficulty in selecting cars for the loading of bulk grain because of many defects in the cars which, if used, would result in leaks. These defects consist of leaky floors, siding, corners, defective door posts, oil and other stains. The one defect that was outstanding to my mind was that many cars of Eastern and Southeastern ownership which had recently received heavy repairs were not fit for grain loading because the boards used in the decking of the cars were not tongue and groove. The lumber, having shrunk, left openings ranging in size from 1/8 inch to a full inch. Naturally these cars could not be used for grain loading, and some of them had been carded as fit for grain at terminals, moved empty for several hundred miles to the grain territory, and then found unfit for loading without the trouble of considerable recoopering and the use of car liners.

During the past few years many shippers have adopted the so-called unit-tie method of loading freight. This plan involves the strapping of the lading in units in the car, the idea being to create a floating load, giving the units a chance to shift if there be any undue rough handling. One of the first requisites in employing this method of loading is a car with a good level floor. Therefore, in classifying cars for loading with commodities such as enamel ranges and stoves, refrigerators, machinery, barrelled commodities, etc., it is important that a car with a good floor be furnished and care should be taken not to use a car where there is a hump in the floor, which ordinarily means an uneven load and consequent damages.

Cinder- and Smoke-Proof Cars Essential for Some Lading

In the selection of cars intended for the loading of paper, sugar, flour, other mill products, lumber and freight in cartons it is important that a car be selected that is entirely weatherproof, and in that we must include cinder and dirtproof. I have in mind numerous claims, many for very large amounts, which have been paid in the case of lumber, flour, sash and doors, etc., where cinders and smoke have entered car in transit, creating damage to the lading. In most of these cases the entrance of the cinders, rain or snow, occurred through the roof or around the side doors. Here again we are faced with a situation which can only mean one thing in the way of inspection, and that is inspection from the interior of the car with all doors closed, so that we can develop whether holes or openings are present which will permit the entrance of foreign matter causing damage to lading.

The adoption of special equipment for the transportation of automobiles has involved many problems for the car department people, and I can not overemphasize the necessity for a 100 per cent inspection of cars set for loading at the automobile plants. Such inspection should cover fully the various parts of the loading device. Where there is any doubt whatsoever as to whether the device is in condition to transport safely another shipment of automobiles, the car should be bad ordered and given necessary repairs before being used again.

The general thought throughout the country seems to be that any old car is a fit merchandise car, and the practice pretty generally is to card rough box cars for merchandise loading. The value of a car of flour, mill products, etc., is ordinarily $300 to $2,000. We use the best car that we have on the railroad for that commodity. We have every conceivable thing produced in this country in our merchandise cars, and ofttimes the value of a carload of merchandise runs up to $30,000. Nevertheless we use a rough box smeared with oil and grease, coal, etc., with a poor leaky roof and doors, loose decking and side sheathing, for carrying a load of that value.

Equipment Failures Cause Dissatisfied Patrons

One item of expense and dissatisfaction to patrons is the delay item. The A.A.R. Freight Claim Division report of 1936 shows that Class I carriers expended $796,000 in that year as compared with $618,000 in 1935, an increase of $178,000, or 28.8 per cent. This item shows a much greater percentage of increase than the general loss and damage bill. The largest portion of the delay bill is chargeable to fruits and vegetables, meat, dairy products, including butter, eggs, cheese, etc., and livestock. In analyzing many of the claims that are paid as a result of delay to these particular commodities, we find that mechanical defects which caused setting the cars out either in terminals or between terminals for hot boxes, brake rigging, etc., were of such nature that they could and should have been detected on the empty movement to the loading station and prior to the time that the car was loaded. In other words, in the case of equipment employed in the transportation of perishable freight or livestock sufficient attention is not given to the empty equipment on its return to the loading territory. The car inspector apparently assumes the attitude that the car is only an empty, and someone beyond him will see to it that it is thoroughly inspected before it is placed for loading. The result is that often, particularly during the cold months, we find the packing in the journal boxes all pushed up in a wad, with the result that when car reverses movement, a condition has been created wherein hot boxes occur.

Not only do we delay the particular car by setting it out but often we delay the train carrying that car to the extent that it misses its connections. That train may be carrying 50 to 70 perishable or livestock loads that may arrive at destination late. Where we have a decline in market, losses are sustained, and we are called upon to assume them.

With this explanation, I am sure efforts are going to be made to intensify inspection of empty equipment, as well as loaded equipment, and more particularly in the case of cars which we know are going to be loaded with commodities subject to market fluctuation.

Where we are unfortunate enough to have cars containing perishable or livestock set out either between terminals or at terminals because of a mechanical failure or a hot box, every effort should be made to repair that car promptly, and get it started, with a view of making up the time that is lost and get the car to its destination on schedule.

We may feel that many of the items that are resulting in large expenditures of money through the freight-claim channel must happen—that they are incidental to our transportation system and that there is no corrective action necessary. In the Chicago terminals some few years ago we were setting out hundreds of cars containing perishable, and paying out thousands and thousands of dollars in loss and damage claims because of delay, until one of your members, C. J. Nelson, who is now superintendent of the Chicago Car Interchange Bureau, arrived on the scene. Our trouble was immediately minimized, and today we are moving perishable through the Chicago terminals close to 100 per cent on time so far as mechanical defects are concerned. It can be done.

Applying the Loading Rules

Another item of expense that we feel can be improved with your assistance is the $390,000 that the Class I carriers paid out during the year 1936 in the settlement of claims brought about because of damage to shipments of machinery. In an effort to eliminate such claims, we on the Milwaukee have inaugurated a system whereby when a shipper orders a car for machinery loading the agent at the origin station immediately notifies the local car-department representative so that the latter can arrange for an inspection of the machinery at the time the shipper starts to load. The carman being present when the loading starts, will be in position to give the shipper advice as to just what is necessary in the way of blocking, bracing, etc., and thereby not only render real service, but at the same time eliminate the possibility of a claim. At the same time, he furnishes our office with the car number, destination, routing, etc., and we, in turn, pass the information to the various operating divisions as well as connecting lines in the case of inter-

line shipments, asking that the car be given careful handling all the way through to destination. The results generally have been highly satisfactory.

In carrying out our loss-prevention program, we in the claim prevention end of it have been faced for many years with a lack of information as to the exact cause for damage, particularly in the case of carload commodities where the car arrives at its destination with the lading shifted, bracing or blocking displaced, and evidence pointing to hard usage in transit. We know that in many instances where unusual handling is assigned as the cause for damage such is not the case. On the contrary, the shipper or the shipper's forces rather have failed to load and protect the lading in a way that would eliminate damage even though the car did receive ordinary handling.

For instance, we will find that a shipper will go to the expense of purchasing lumber of a suitable quality, free from knots, brash, dry rot, etc., and then will undo his good work by failing to use proper dimension nails or spikes in securing bracing or blocking in the car. In other instances, sufficient thought is not given to the application of the protection, with the result that it does not serve the purpose for which it was intended.

I do not know of anyone on the railroad who is better equipped than a carman to inspect and advise as to the condition of a shipment either in the process of loading or unloading. Once he has developed information indicating the need for corrective action as far as the shipper is concerned, that information should be passed immediately to the loss prevention organization on his railroad, so that action can be taken diplomatically with the shippers.

One place where we have some real work to do is in connection with our inspection of shipments loaded on open top cars, this conclusion being the result of observing inspection activities insofar as this particular class of freight is concerned, and also based upon an analysis of accidents involving such commodities. The carman is usually particularly attentive to the running gear in all cars in the train which he is inspecting. When he comes across an open-top load, he should take sufficient time to examine the manner in which car has been loaded thoroughly, and satisfy himself that adequate and sufficient protection in the way of blocking, bracing, etc., has been applied to keep the shipment from shifting or tipping over. I refer to such shipments as contractor's equipment, clam shells, roadway machinery, tractors, auto trucks (moving on flat cars or in gondolas), automobile frames, welded steel pipe, generators, bridge and structural steel. Vibration plays a part in displacing loads of this nature from their original position, as does unusual handling. In my opinion they should receive more than the ordinary inspection. We have asked our train and engine crews, as well as our agents, to watch loads of this nature, so that we may avoid serious accidents and the payment of large sums of money on such commodities in the way of loss and damage claims.

Reduce Damage in Picking Up Wrecks

Most of you have jurisdiction over the employees assigned to wrecking outfits, and it is your duty from time to time to go out on the railroad and supervise the picking up of derailments or accidents. We have always felt that the use of a lot of good common sense at times like these would save considerable money for the railroad concerned.

The most important consideration in railroading is a main track which will permit operation of trains. At the same time a lot of damage to the cars involved in derailment as well as to the contents can be eliminated by doing the job just a little more carefully. Where it is impossible to rerail or retruck a car without undue delay, then the next best thing is to set it upright alongside the track where the contents can be salvaged later on after the main line has been restored to operation, rather than to turn the car over, causing not only damage to the equipment but, worse yet, to the contents. It has been our experience often times that considerable money could be saved by removing the contents of a derailed car and hauling them by truck to the nearest side track where they could be loaded into other equipment, instead of trying to pick up the car and the contents. Generally speaking, when such action is taken the lading shifts, shearing off a part or all of the superstructure, thereby causing heavy damage to the car and to the lading.

The Neglect of Hidden Defects

An item that I am sure can be worked out by your organization and one that is important is the proper disposition of freight equipment that has been responsible for damage caused by some hidden defect in that car that could not be detected by visual inspection. We have had any number of instances where claims ranging from $300 to $1,000 have been paid because freight was loaded in a car that had a defective roof, doors, etc. The claim-prevention organization in many instances did not hear about the case until the claim was paid and after the car had been unloaded and placed back in freight service.

Where we have a car that is defective and has caused damage, some definite action should be taken to repair it, so that it will not be placed back in service and cause the same damage over and over again. The mere changing of the classification card reducing a car of this nature from a high classification to a lower category does not correct the condition, because the next car inspector who inspects that car will record it to a higher classification, not knowing that a defect exists. This again brings out the importance of the inspector whose duty it is to classify cars for commodity loading, and how important it is that this work be confined to the daylight period, giving him an opportunity to do his job as it should be done. I hope that some plan can be worked out whereby some definite action will be taken either to repair a car that has been responsible for causing a large loss because of some defect, or that the information will be passed on to the line owning the car so that they may take such action.

On the Milwaukee we have asked our agents to mark with white chalk inside of the car the defects, so that they will be readily seen by the car inspector. He is also requested to tell the dispatcher that this particular car has caused damage due to some mechanical defect and to move it to the first repair point where there is a carman located, so that he will be able to make the proper inspection and take the necessary action to correct the condition.

Things to Be Avoided in Rebuilt Cars

New equipment and cars shopped for heavy repairs and rebuilding should be better cars than any we have in service at the present time if we give proper consideration to the various items that are causing loss and damage claims, which I am sure will not increase the cost materially. I have in mind, for instance, many cars equipped with steel threshold plates which have not been countersunk flush with the floor or cut off so that they will not protrude beyond the doorpost. Where steel threshold plates are employed, holes not less than 1½ in. in diameter should be placed 6 in. or 8 in. apart the entire length of the plate, in order to allow shippers to

apply doorway protection. This is also true of steel doorpost plates. In many instances, nailing strips are being applied to the doorpost that protrude as much as 1½ in. beyond the side walls of the car, creating hazards which are bound to result in damage to lading contained in sacks or cartons. The bolts used in securing the decking and siding in many instances protrude beyond the lumber to the extent that they also create additional hazards.

In an effort to counteract condensation in steel roof equipment, which is a very troublesome item from a loss-and-damage standpoint, openings at the eaves and ends of the car have been provided, intended for ventilation. This has not corrected the trouble but to the contrary has created additional opportunities for damage because dust, cinders and the elements enter those openings. I hope that something can be worked out to correct this condition.

The type of door used on many of our box cars is loose and herein lies one of the greatest opportunities for damage to freight due to water, dirt, etc. A door that will completely seal up the doorway opening will go a long way toward reducing our loss and damage bill as well as satisfying our patrons.

The speed to which our freight trains have been stepped up is such that we are handling freight today on schedules that our passenger trains used to travel on. This speed and our present equipment results in vibration that is causing damage to many commodities. I believe that all new equipment, regardless of the character of the car involved, should have stabilized trucks, to reduce vibration. It would be economical from a car maintenance standpoint, as well as from a loss-and-damage prevention standpoint.

Your president, Mr. Nystrom, has made many of the changes that I have enumerated in our equipment, and has many more in mind, so I know that it can be done, and I want to take this opportunity of thanking him for his co-operation.

Remember, in the railroad business we have only one thing to sell, and that is service. When a car is furnished for loading of any commodity and it is not in proper condition safely to transport that shipment to its destination we have not only created damage that is expensive but, worse yet, the dissatisfaction which always follows when freight arrives at its destination in a damaged condition. Surely we must appreciate that our shippers are vitally interested to deliver their products to their customers in first-class condition. Usually they spend large sums of money in preparing their products for shipment in an effort to accomplish this result, and when they arrive in a damaged condition they can not help but feel that the railroads are responsible.

Discussion

In the discussion following Mr. Ennis' paper, the importance of the cotter key as a protection against loss, damage and delays was stressed. The campaign for the improvement in the condition of cotter keys in brake rigging developed on the Richmond, Fredericksburg & Potomac was described. Much has been accomplished by the use of samples of incorrect and correct methods of cotter-key insertion in reducing the frequency with which these keys have to be replaced. For one thing this has reduced inspection delays.

Weaknesses in the construction of auto loaders was brought out as one cause of damage to automobiles in transit which cannot be overcome by inspection prior to loading. Cars on the upper loader are damaged due to weakness and looseness in the sway bolt. Both the top and bottom automobiles are damaged when the members shear at the floor wells. The suggestion was offered that these wells be eliminated and a flush type of floor casting employed instead.

The effect of increased freight-train speeds in increasing loss in damage was also referred to. This has been particularly noticeable in the case of eggs which are developing minute cracks to a much greater extent than ever before.

Economics of Private Freight-Car Operation

Many special types of cars developed to return commodities of great value to the rails

By Leroy Kramer

Vice-President, General American Transportation System

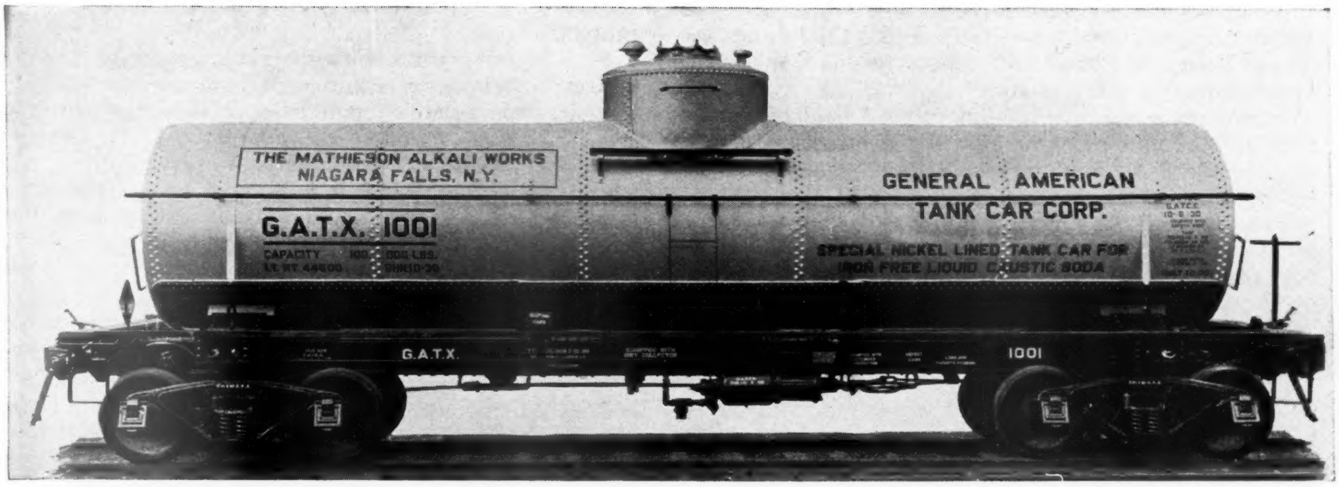
Efficient car department work is an important cog in the intricate operations of this country's great transportation machine. We, in our operations, have much of common interest with you, particularly in those matters of daily occurrence connected with the proper maintaining of cars in running condition.

There is some confusion as to just what types of cars were first built either by shippers or independent owners, but at one time every type of car came in this category. At the present time the private-car supply is largely confined to tank and refrigerator cars, although there are still some stock and open top cars privately owned. Evidently the economics of operation began working against the other types of cars. The railroads began furnishing more completely those standard types which their shippers required, and they have done such a good job of it that it is rare to find a movement of normal commodities that cannot be handled by the standard railway equipment.

65 Types of Tank Cars

On the other hand, and with particular reference to tank cars, there was such a shifting of production from one territory to another, and such a multiplying number of commodities requiring different capacities and types of cars, together with seasonal movements, that it would have proven very burdensome to the railroads to have been compelled to make huge investments to meet these unusual requirements. They did not have the facilities nor the experience adequately to supply the ever-changing conditions, and it is generally agreed that the private cars engaging in these lines of activity have relieved the railroads of very costly and uneconomical operation of special cars.

The private car companies make it their business to exert every effort to furnish equipment that will keep freight on the rails. Having organizations devoted to this purpose, it is natural that they have been able to



Nickel-lined tank car for transporting iron-free liquid caustic soda and other chemicals which attack steel

produce these results because of their constant and patient study of the shippers' requirements and the development of cars to meet those needs.

An interesting angle to car supply is that in a single year our company handled 110 different commodities in tank cars which required the use of 65 types of cars. We are still developing new types to retain or bring back shipments to the rails. No single railroad or group of railroads could possibly justify the ownership of all these various types of cars, nor supply them properly and promptly, and keep them distributed to the various industries and sections of the country to meet the widely varying needs of liquid shippers. With rare exceptions railroads do not own tank cars other than sufficient for their fuel oil requirements, yet no railroad today need suffer any revenue loss from liquid shipments, because they can call on the existing private car companies and get the right type of car on short notice.

Lest someone mentally wonder whether the railroads are paying too great a price for this service, let me remind you that the mileage rate paid by the railroads on tank cars is less than the mileage rate paid by a single passenger per mile and, what is more important, is less than the cost of ownership of these cars. The difference is made up by the shipper agreeing to pay a normal rental, depending on the type of car, and this justifies the creation and operation of tank cars. And also remember that tank cars run on rails and not on roads, so that the revenue in such cars accrues to the railroads, and no mileage is paid when these cars are standing idle.

Refrigerator Cars

What about refrigerator cars? The railroads, either through direct or controlled companies, own about 85 per cent of the refrigerator cars. The remainder are privately owned.

Are these all alike? They are not. Some are specially designed for packing house business, some for dairy products, some for certain fruits and vegetables from territories that differ from cars to handle fruits and vegetables from other territories. Inside lengths, widths, and ice bunker capacities, as well as types of bunkers, vary to meet the different requirements of the products or the shippers.

There cannot be too much emphasis placed upon the necessity for furnishing the shipper the kind of car that he wants. He has his shipping problems and has competition with those who do not ship by rail. He must have a car of the proper length to contain his standard carload, and not too much center bracing which costs money. Ice bunker capacity must suit him, and the car must be capable of giving him the right temperature. He may require cars in a particularly clean condition as compared with those that are used in miscellaneous service. He may not be able to use a car with any odor for certain shipments, and above all, he wants these cars in the right number and at times to suit his convenience. Generally speaking, private car companies have been more attentive to the shippers' requirements, which again has been a tremendous influence in retaining many such shipments on the rails instead of their going to competing truck transportation.

Railroads who own or control cars are generally those which have territories engaged in producing fruits and vegetables in large seasonal quantities. Many other railroads do not have such seasonal crops, but in the normal production of fruits, vegetables, butter, eggs, poultry, packing-house products, etc., need a variety of cars which experience has taught them it is not economical for them to own. In such instances they have leased their requirements from private car companies who furnish the capital and the maintenance, but turn the cars over for operation to the railroads for their distribution and movement. This places them on the same basis competitively with railroad owned or controlled cars.

Some Striking Facts

The following few items indicate the widespread production of perishables, and will doubtless impress you with the fundamental basis of special car operation to meet demands from widely separated sections of the country at various seasons of the year. Again the greatest influence is service to the producer, and this service has to be met in the most economical manner possible.

The most surprising bit of information is the fact that the railroads handle more tonnage of milk and milk products every year than they do of steel. A large volume of this milk was returned from trucks to the railroads when our company developed the glass lined bulk milk car.

Without including homemade or local production, several hundred creameries produce for rail transportation over a billion five hundred million pounds of butter, one-third of this coming from Minnesota, Iowa, and Wisconsin.

No one can even guess the total production of eggs, but the cities of New York, Chicago, Boston and Philadelphia annually receive by rail more than 6,500,000

cases of 30 dozen eggs per case. The largest egg producing state is Washington, followed by California, New York, Iowa and Illinois. Certainly this is a diversified business over a large territory.

Minnesota leads all states in dressed poultry production, and the four cities mentioned above receive between nine hundred million and one billion pounds annually by rail.

Potatoes lead the vegetable and fruit tonnage. Apples are second. Washington originates 40 per cent of all the apples shipped by rail. California ships 70 per cent of the oranges and 99 per cent of the lemons. The southern states—Florida to Arizona—are all increasing their productions rapidly.

Eighty-five per cent of the perishable products handled on rails are grown or produced west and southwest of Chicago and south of the Ohio river. The bulk of this is consumed east and north of those boundaries.

Why Private Car Companies?

The economics of private car companies are generally based on the following reasons:

1. A service need by a shipper or a railroad to protect the loading requirements.
2. The desire and ability to develop and furnish for service those types of cars not generally owned by the railroads.
3. A closer contact with the shipping public and the desire to meet their requirements can only be done by organizations small enough to appreciate the needs of such shippers.
4. The private car companies, in serving their customers, have established standards of service that have been progressive and standards of maintenance that have been generally better than the standards of the railroad.
5. The use of private cars by railroads on a mileage basis is the cheapest thing bought by railroads today. I am entirely familiar with the cost of ownership and operation of railroad freight cars, and I make the above statement with full knowledge that every other commodity bought by the railroad has increased materially in the last few years, averaging about 40 per cent for materials, and yet the railroads are paying the same mileage rate today that they have for several decades. I realize that this rate is a matter of averages. It may produce profit in one direction and losses in another, but on the whole, in good times or bad, the use of cars on a mileage basis has been cheaper to the railroads than it would be if they owned and operated similar types of cars.

A.A.R. Mechanical and Loading Interchange Rules

Factors in interchange inspection which influence operating costs

By C. J. Nelson

Superintendent of Interchange, Chicago Car Interchange Bureau

With the enormous amount of money the railroads have invested in cars it would seem quite proper to assume that the car department is of great importance in the transportation game, and that car-department employees carry far-reaching responsibilities. I believe that meeting and conferring with each other, as on this occasion, will go far toward helping us in this responsibility.

We know that the carmen have not been lagging in progressive activity, and I intend no criticism in this paper to indicate some of the details that might be advantageously handled differently than they are today. I have confined my comments to details having to do with car handling and operation.

I doubt that there is any group of workmen connected with railroading who are governed by nearly as many rules and regulations as are the car inspectors, having in mind such rules as the A.A.R. Mechanical Rules of Interchange, the A.A.R. Loading Rules, the Safety Appliance Regulations, the rules covering the handling of explosives, the railroad clearances, etc.

It requires a well-trained mind to understand and retain them, and failure to do so is bound to result in heavy losses and possible injury or loss of life. That same mind should also be well enough trained to exercise good judgment in cutting cars out of service, and I have, apparently to no avail, constantly endeavored to impress on the minds of all concerned that injudicious shopping of cars is creating enormous losses, but I am still hoping that some kind of united and remedial action will be taken to curtail it.

Time will not permit doing justice to this detail, and I will, therefore, briefly suggest that consideration be given to the following recommendations: (*a*) When failure or wreck occurs on account of a car defect, higher officers should bear in mind that indiscreet or terse criticism might affect the judgment of sub-officers and employees to the extent of making them over technical. (*b*) Have traveling or higher supervisors make periodical surprise checks of repair tracks to ascertain whether or not some of the loaded cars could have continued to points of unloading without repairs. (*c*) Make greater effort to educate present and potential car inspectors, with a view to making them better qualified to properly perform their duties. (*d*) Insist on reasonable time being allowed for inspection.

I was requested to make some comments on interchange, and in doing so, I again call attention to the deplorable fact that the A.A.R. Mechanical Rules of Interchange are, too frequently, being willfully violated. While I could cite many concrete cases, it will probably suffice to use a recent and outstanding example. I refer to revised Rule 36, effective August 1, 1936, which, as you know, prohibits the use of red printing or red background on placards used by the railroads. Realizing that it would be costly to destroy the large stocks of such cards on hand at the time the rule was changed, the Chicago roads were allowed nine months to exhaust them, with the warning that the rule would be literally enforced at the expiration of that time.

While some roads had taken action toward providing proper cards, we discovered, when the rule was finally enforced, that the percentage was small, and that the great majority of all the roads had done practically nothing to meet this requirement. The results were that thousands of defect cards were issued in Chicago, that an enormous amount of time and money was unneces-

sarily spent, that we received bitter protests from all parts of the United States, and that we were repeatedly charged with being over technical.

Furthermore, we know that so-called gentlemen's agreements are in existence at many points, to simply remove the cards from cars, without defect carding, which, of course, means that when the painful penalty is not applied, no action will be taken to eliminate such placards.

It is also a well-known fact that agreements are in effect between some roads to waive important requirements of A. A. R. Rules 3 and 4 in the interchanging of cars between themselves, all of which, to no small extent, defeats the intent of or nullifies the object sought by the Association of American Railroads, and it would seem that this Association should do all within its power to discourage such undesirable practices. I realize that some local conditions might exist which would make it desirable to deviate somewhat from certain rules, but I feel that it should never be allowed without procuring permission from the Association of American Railroads. In fact, considering the time and money spent in developing A.A.R. regulations, I have never been able to understand why the members are breaking faith between themselves in this manner.

In briefly dealing with the Loading Rules, I must again refer to the car inspectors by reason of the varied and fluctuating action they take in connection with the shopping of cars for load adjustments. Some use excellent judgment, while too many others do not, depending mostly on the manner in which they have been instructed.

Many companies simply furnish books of loading rules to their inspectors with instructions to be governed by them, and emphasizing that failing to do so literally will be deemed a serious matter. Under such circumstances inspectors do not dare to pass a load along unless it is secured strictly in accordance with the rules. I have in mind cars shopped for adjustments simply because the blocks, braces, etc., are a fraction smaller than specified in the rules, and cases where large concave blocks, A-braces, etc., are used as substitutes for the much smaller blocks and inferior methods provided for in the rules.

We know of many similar cases where cars are being shopped for adjustments, irrespective of the fact that the loads are intact and perfectly safe. Such action, however, is seldom taken by inspectors who have been properly coached, and who are permitted to exercise their own judgment to a reasonable extent.

While we are entirely justified in being exacting when inspecting loads at shippers plants, so far as enforcing compliance with the rules is concerned, I know that thousands of dollars could be saved, and that many irritable delays could be avoided by the use of common sense in connection with such loads in transit. In other words, I would strongly urge that we refrain from adjusting loads enroute by reason of not being secured exactly in accordance with the rules, if they appear safe enough to continue to destination, with the understanding that each case of improper loading shall be promptly reported, and that immediate action shall be taken with shippers for correction.

Another outstanding example of apparent inefficiency, worthy of consideration, is the preventable penalties the carriers have suffered in connection with the handling of scrap iron. For a number of years loading rule 261 provided that when scrap iron extended above the "car sides or racks," it could be secured with a "sufficient number of strands of 1/8-in. diameter wire to prevent it from falling off." The wording of this rule was somewhat revised in the simplified book of rules (Fig. 115), published in 1934, but without changing the intent. Immediately thereafter, however, the shopping of such loads for transfer or adjustment increased to an alarming extent, which appeared to be mostly due to metal parts being used as substitutes for racks, consisting of boards nailed to wooden stakes.

This, by urgent requests of a number of railroads, resulted in Fig. 115 being changed in 1935 to prohibit the use of such substitutions, but the dangerous loading, transferring and adjusting still continued, and because of this proving unsatisfactory and producing no better results, the 1934 rule was reinstated on January 1, 1937.

V. R. Hawthorne, Secretary, Mechanical Division, Association of American Railroads, knowing that the committee on Loading Rules was at its wits end, had an extensive investigation made by his field men who finally reported that regardless of expense a practically fool-proof rule would be the only remedy, which resulted in the issuance of Circular No. D. V.-902 on May 4, 1937, outlining a further change in Figure 115.

The rule as it now reads would, if rigidly enforced, prove unreasonably expensive and very irritating to shippers, but it is rarely being complied with, and I am now wondering if the 1937 rule should not be restored.

The committee on Loading Rules felt, and I would say properly so, that because there are so many different kinds of scrap iron, a rule permitting such lading being secured as economically as possible would be most desirable, assuming that the railroad men should be well able to decide whether or not it was tied together, or down, thoroughly enough to make falling off the cars in ordinary train handling impossible.

Knowing from experience that a good safe load can be built up to a reasonable height above the top of car sides with such metal parts as pipe, beds, auto chassis, auto wheels and car roofing, by tying them together with wire, I believe that lack of proper action, proper supervision, proper coaching of shippers and employees are the principal reasons for this trouble, rather than the wording of the rule.

If you will make a check, I believe you will find that most of the few scrap dealers who have a book of loading rules know practically nothing about its contents, and that it was either mailed or handed to them without explanation of any kind covering the application of Fig. 115. That is also true with many shippers of other commodities.

It would seem to me that all railroad patrons shipping material on open-top cars should receive a book of loading rules, and that in every case where a rule has been changed, a competent railroad representative should visit each shipper who manufactures the commodity covered, and explain to him why it was revised and what it means. In cases where only one commodity, such as scrap iron is being shipped from a plant, a letter to the shipper, instead of a book of rules, might prove more effective and economical.

Now a few words about the experimental load card shown as Fig. 1 of the loading rules. This card was adopted to assist the Committee on Loading Rules in determining whether or not certain methods of loading freight on open-top cars are sufficiently safe to warrant recommending them to the Association of American Railroads for mandatory rules.

While it seems reasonable to assume that executive officers fully realize the importance of these cards, it is quite evident that the great majority of employees do not, which again reflects the fact that they are not being as thoroughly instructed as they should be. This statement is based on the fact that a few roads are making a fine job of reporting irregularities found on such loads in

transit, or at destinations, often furnishing sketches, photographs, etc., while others are so incomplete and unreliable that they are of no value at all to the committee. In other words, some roads have demonstrated beyond doubt that the necessary details can be correctly reported, if the employees making such reports know just what is desired. It is a rather difficult task to make these reports fully understandable, and few employees, such as car inspectors and agents, can do it without constant guidance by well-versed supervisors. Only a small percentage of these cards are being mailed to Mr. Hawthorne, and it is a well-known fact that they are frequently being ignored by employees who do not fully understand what to do with them.

With the tremendous speeds of our freight trains today, the loading of material on open-top cars has become an exceptionally serious matter, deserving our very best efforts. I know that the Committee on Loading Rules has, in recent years, devoted more time to this than ever before, and I also know that far better results are possible if all the railroads will co-operate as thoroughly as they should.

Another condition which should be of great concern to every railway employee is the destructive effect of excessive impacts of cars in yard switching. Despite the fact that operating officers are continually endeavoring to bring about improvements, I doubt that it is being curtailed to any great extent, if at all.

In the Chicago territory, about 3,500 open-top cars must be placed on shop tracks each year on account of the loads, which had originally been secured in accordance with the loading rules, having been shifted to the extent of making them unsafe to handle in road trains. This only applies to adjustments in interchange, and I believe that figures showing the total number in the United States, and cost, would reveal that the enormous consequential losses are far from being fully realized by the carriers; the figures would, of course, be greatly increased if the closed cars were included.

Many of the commodities involved remained intact when they were subjected to switching impact tests, up to at least 8 m.p.h., under the directions of the Committee on Loading Rules, making it safe to say that these speeds are too often exceeded in what is called ordinary yard switching. If figures could be produced to show the cost of the damage to cars handled in this manner, they would probably prove equally as alarming as those previously referred to.

This being an operating problem, some of you may feel that I am somewhat out of line in bringing it before you, but I am doing so by reason of knowing that carmen can co-operate in this far better than they have in the past.

We can go into most any classification yard and see cars crashing against each other, apparently unobserved by our car inspectors, and about the only time anyone pays any attention to this is when a car is seriously damaged. I fully appreciate how difficult it is to work out a well-defined remedial plan, but I firmly believe that it can be done, and that car-department officers should take more aggressive action in the matter than they are now doing.

C. H. Dietrich, Executive Vice-Chairman, Freight Claim Division of the Association of American Railroads, being much concerned about the large sums of money paid out on account of freight being damaged by improper handling, recently called a meeting at Chicago, and earnestly appealed to the many railroad men present to increase their efforts for better results.

I know that the deep impression he made will result in an energetic campaign being inaugurated, and feel confident that the carmen will fulfil their obligation, so far as co-operation is concerned.

Discussion

Mr. Nelson's paper brought out a lively discussion on the effects of switching impacts and on certain provisions of the loading rules. While high-speed switching impacts were rated as major factors in creating loss in damage claims, the effect of impacts due to uncontrolled slack in road movement came in for a share of the responsibility. At the end of the discussion a resolution was passed calling to the attention of the Association of American Railroads the belief of the Car Department Officers' Association that a study to determine the maximum desirable switching speed, especially for house cars, would be very helpful. While it was generally recognized by those taking part in the discussion that the establishment of such a maximum speed by the Association of American Railroads would be of little value for disciplinary purposes, it could be used effectively in a campaign of education to improve the conditions at present prevailing.

The discussion on the Loading Rules dealt with the handling of poles on flat cars, loading of heavy machinery and light-scrap loading. It was evident that considerable difficulty is being experienced in the shifting of the load where poles are moved on flat cars, with

"While high-speed switching impacts were rated as major factors in creating loss in damage claims, impacts due to uncontrolled slack in road movements came in for a share of the responsibility"

heavy expense for readjusting the loads. More difficulty is experienced where creosoted poles are loaded on bearing strips than when they are loaded on the car floor, although the bearing strips to some extent protect the poles at the bottom of the load from damage. Some improvement in the shifting of these loads was reported where the cars are handling at the head ends of trains. The use of high-tensile bands, applied taut over the load between the end stakes, using the stake pockets for attachment to the car. Where such bands are used it was recommended that shims be applied to protect the poles.

Difficulty has been experienced because of high load concentration with certain heavy machinery, such as drag-line excavators. Cases were cited where this concentration had caused the truck springs on one end of the car to go solid, resulting in derailments. In other cases the concentration of the load through the tractor crawlers at the sides of the cars caused serious distortion of the side sills.

The discussion developed the fact that none of the roads represented at the meeting are complying literally with the scrap rule. Considerable criticism of the rule was voiced so far as it applies to light scrap which must be loaded 4 ft. or 5 ft. above the top of the car in order to get a minimum load and which contains no flat material suitable for building up retaining walls above the car sides. Such loads were said to be unsafe when the binding over the load was depended on because the material settles and the retaining wires become loose.

Address by J. T. Gillick

J. T. Gillick, chief operating officer, C. M. St. P. & P., expressed his satisfaction at the fact that the car men were again getting together for a discussion of the problems of car operation and maintenance. A mismanaged car department, he said, is the most annoying and expensive thing which can be on a railroad. Much intelligent planning is required to adjust car maintenance to fit a fluctuating income and this will be increasingly difficult with the higher costs now imposed on the railroads.

Everyone, he said, takes it out on the railroads; industry passes on increases in its costs, which the railroads have to pay. The railroads, however, cannot pass on increases in their costs and it is, therefore, up to the car department to carry on its functions without increasing costs. To accomplish this, he said, there must be an exchange of ideas such as is provided by the convention of the association. Among the agencies which are available for the assistance of the car department in accomplishing its difficult objective he mentioned the increase in the employment of welding, the use of power jacks and others which are effective in saving time and can be used for the reclamation of material.

Mr. Gillick held forth no hope of a rosy future for the car men. With freight trains operating at passenger-train speeds, he said that more attention must be given to the condition of air brakes and trucks; there must be a more rigid inspection of draft gears and, while the journal box situation has improved in recent years, it is still far from satisfactory. He cited the changes in passenger-car equipment which are such that he was not sure whether a car repair man or a watch maker were most needed. He pointed out the tremendous importance that attention to little things plays in the successful operation of passenger trains at speeds of 100 miles an hour if interruptions of the performance are to be prevented, and always the cost must be controlled. To accomplish all these things, he said, was expecting a great deal. He expressed his confidence, however, in the car men of the country to meet the new situation as successfully as they have always met their problems in the past.

Discussion of the Interchange Rules

The discussion of the Interchange Rules was led by M. E. Fitzgerald, general car inspector, C. & E. I. In opening the discussion Mr. Fitzgerald spoke of the difficulty of securing complete adherence to rules violations of which are accompanied by penalties. It was his suggestion that the work of the field checking committee of the Mechanical Division, Association of American Railroads, be extended to other phases of the observance of the Interchange Rules than billing. The surprise element in such a system of checking he thought would increase the respect with which the rules are observed just as it had increased the care exercised in rendering bills which conform with the work done. One of the speakers during the discussion asserted that the field committee is working along the line suggested.

For the purpose of effectively bringing out changes needed in the rules, Mr. Fitzgerald suggested that an A.A.R. committee be appointed by the Car Department Officers' Association to seek proposals for changes on the part of the roads represented in its membership, to study and bring these changes before the executive board of the association, and then to present its proposals on the floor of the convention for discussion. Changes adopted by the association following this procedure would then be proposed to the Mechanical Division by the association. On motion, the suggestion for the appointment of such a committee was adopted.

Break-in-twos caused by drooping couplers, and slack in draft gears were the subjects of a considerable part of the discussion which followed Mr. Fitzgerald's presentation. The general practice of shimming up truck springs to restore the height of drooping couplers was considered unsatisfactory by one member, because it did not correct the coupler condition. The coupler still remained out of line, thus being subjected to damage and subjecting the draft gear to abusive treatment. A number of break-in-twos were reported in which the distance from the top of the coupler shank to the striking casting was 2¾ in., instead of the normal ¾ in., permitting the couplers to creep up and slip by. The speaker advocated the use of shims on the carrier iron, rather than in the truck, and also suggested the spot welding of a suitable shim on top of the shank in cases of excessive play between the coupler shank and striking casting. Another member, however, questioned whether it might not be necessary to anneal the coupler if any welding were done upon it. Several speakers expressed the opinion that it was time for the adoption of a rule on draft-gear inspection.

First Meeting of

Fuel and Traveling Engineers

Four-day convention held at Chicago is notable for the number of addresses and committee reports presented, and range of subjects covered

Association since the amalgamation of the two parent associations was held in the Hotel Sherman, Chicago, September 28 to October 1, with a total registration of railroad members and guests of 494. The meeting was under the direction of President J. D. Clark, fuel supervisor, Chesapeake & Ohio, who said in his opening remarks that the union of these two groups was the greatest step ever taken by either in furthering their mutual objective of conserving fuel and promoting and improving the efficiency of locomotive service.

This objective was unquestionably furthered to a substantial degree by the constructive program of individual papers and committee reports* provided by the officers of the association, with all details worked out and co-ordinated through the effective efforts of Secretary-Treasurer T. Duff Smith. Special features included addresses by M. J. Gormley, executive assistant, Association of American Railroads; Roy V. Wright, editor, *Railway Mechanical Engineer;* W. H. Flynn, general superintendent motive power and rolling stock, New York Central; L. K. Sillcox, first vice-president, New York Air Brake Company†; and Eugene McAuliffe, special representative, Union Pacific. Owing to unavoidable absence from the meeting, Mr. Flynn's address was read by A. A. Raymond, superintendent fuel and locomotive performance, New York Central.

One of the high points of the convention from a human standpoint was the address by Mr. McAuliffe, who was responsible probably more than any other one man for the founding of the original International Railway Fuel Association in 1909. Mr. McAuliffe intentionally avoided discussing the technical side of railway fuel used and reminisced regarding men responsible for and events leading up to the development of this association which has proved such an important factor in railway fuel conservation efforts.

Election of Officers and Executive-Committee Members

Officers elected for the ensuing year were: President, J. C. Lewis, road foreman of engines, Richmond, Fredericksburg & Potomac, Richmond, Va.; vice-president, G. M. Boh, district road foreman of engines, Erie, Hornell, N. Y.; J. R. Jackson, engineer of tests, Missouri Pacific, St. Louis, Mo.; and A. A. Raymond, superintendent fuel and locomotive performance, New York Central, Buffalo, N. Y. Executive committee members elected for two years are W. H. Davies, superintendent of air brakes, Wabash, Decatur, Ill.; E. E. Ramey, fuel engineer, Baltimore & Ohio, Baltimore, Md.; W. C. Shove, general road foreman of engines, New York, New Haven & Hartford, New Haven, Conn., and R. S. Twogood, assistant engineer, Southern Pacific, San Francisco, Cal. Executive committee members elected for one year are: L. E. Dix, fuel supervisor, Texas & Pacific, Dallas, Tex.; J. J. Kane, road foreman of engines, Lehigh Valley, Sayre, Pa.; G. H. Likert, fuel engineer, Union Pacific, Omaha, Neb., and C. N. Page, supervisor fuel, Lehigh Valley, Bethlehem, Pa.

Address by M. J. Gormley

A feature of the first day's session was an address "Relations of Fuel Supervisors and Traveling Engineers to Economy of Railroad Operation" by M. J. Gormley, executive assistant, Association of American Railroads. Mr. Gormley said that the railroads are the largest buying agency in the United States and in 1936 spent more than $800,000,000 for fuel, materials and supplies, one-third of which was for fuel. The remarkable progress in the economical use of fuel, Mr. Gormley said, is indicated by the fact that, in freight service, each ton of fuel produced 12,452 gross ton-miles in 1932, this figure being increased to 16,746 gross ton-miles in 1936, an increase of 34.5 per cent in efficiency. In passenger service one ton of fuel produced 110.8 passenger-train car miles in 1923 and 130.4 car miles in 1936, an increase of 17.7 per cent in fuel efficiency.

Reduced to the simplest terms, the railways in 1936 moved one ton of freight equipment and lading a distance of one mile for each 1.4 ounces of fuel in 1936 which may be compared with 2.9 ounces in 1923. Mr. Gormley credited this greatly increased efficiency to improved design and construction of locomotives, application of the latest scientific methods of firing, reduction in road delays by reason of improved operating methods and increased train lengths and the effective work of railway personnel in all departments.

With reference to the 70-car train limit bill which passed the United States Senate at the last session, Mr. Gormley said that this is a make work measure and not a safety measure, and that no one knows better than fuel and traveling engineers how much this measure, if adopted, will cost the railroads. He referred to the development and application of the Type AB brake which greatly adds to the facility of train operation and reduces the possibility of injuries due to slack in long trains and said that one of the railroads having the longest trains now has over 40 per cent of its cars equipped with this type of brake. He stressed the great reduction in fuel efficiency which will result from

* One of these reports, "Steam Turbine and Condensing Locomotives," will be published in a later issue.

† The paper "Things to Come in Transportation," by L. K. Sillcox, will be published in a later issue.

handling trains of 70 cars with modern locomotives.

In closing his address, Mr. Gormley emphasized the importance of securing an adequate public appreciation of railway problems and achievements and outlined some of the work now being done along this line by the Association of American Railroads. As regards the responsibility of individual railroad men in fostering a favorable public opinion, he said, "Every railroad man in the country should acquaint himself with the facts about American railroads and should make an honest, constant attempt to pass along these facts to all the people with whom he comes in contact and it would not be long before a big part of our present-day public relations job would be accomplished. We have the best product of its kind available, our prices are fair, and we have an encouraging degree of confidence from the public. Your association has unusual opportunities to present the story of the industry to important people."

Utilization and Availability of Locomotives

Statistical information on power utilization indicates that there is room for improvement

By W. H. Flynn

General Superintendent of Motive Power and Rolling Stock, New York Central System

The subject of locomotive utilization is not a new one and I question if I will be able to add any thoughts to the mass of information which has been presented to this and similar organizations. However, I believe the general subject is of such importance that those of us who are trying to perpetuate successful railroad operation should continually bear it in mind.

Economics

You realize that the locomotive, either in its form as a Diesel, electric or steam unit or in its form as a motor rail car, makes by its production the revenues which accrue to the carriers from operations. The high cost of these units is a familiar subject and only by the maximum utilization can we expect to receive, because of those high costs, a proper return upon the investment. The purchase price of a locomotive, of course, can be prorated with respect to its revenue earning capacity throughout its life but in addition to the high initial cost we are confronted constantly by maintenance costs which likewise must be converted into revenue. When a locomotive is placed in the back shop for heavy repairs and an expenditure of from $5,000 to $10,000 is made thereon, the sooner we are able to run out those repairs the sooner the revenues accruing therefrom are absorbed among the incomes of the carrier.

Utilization and Availability

Before further discussion of the item of utilization, I desire to call attention to the difference between the terms "utilization" and "availability," as I feel that this is of primary importance, in view of the comparisons which are often made between different types of power. Utilization is the actual performance obtained from locomotives and is necessarily a combination of the mechanical condition of the individual unit to perform service and the readiness of that service to be performed. On the other hand, availability is used commonly to express simply the condition of the unit being ready to perform service, giving no consideration as to whether or not such service is there to be performed. Were records available, there is no question in my mind but that the steam locomotive today would indicate a very improved availability as compared with a rather discouraging utilization which is charged against it.

The Effect of Design Upon Utilization

The maximum in utilization of the steam locomotive should begin with the design of the individual unit; each component part thereof must be considered with that thought in mind, weighing the advantages and disadvantages, taking into consideration, of course, the ultimate economics of the situation. Boilers should be designed so as to provide ample grate areas and firebox volumes so that fuel consumption rates can be maintained at a minimum consistent with service demands; this tends toward cleaner fires and assists materially in increasing the length of locomotive runs and decreasing ash-pit time.

Close attention should be given to the economics involved in connection with roller bearings, since this equipment has done much toward eliminating hot journals, and reducing attention required at engine terminals, thereby increasing availability, and consequently increasing the utilization of the unit. Similar treatment for pin bearings appears to be quite close at hand, indicating that we may be rapidly approaching the day when we need have little fear of delays and detentions attributable to hot pins and bearings.

Another feature of locomotive design which has an important bearing on utilization is the introduction of lightweight reciprocating parts, rotating parts and motion work of high-tensile steel, which reduce by as much as 50 per cent the dynamic augment on modern power. This reduction in dynamic augment has been looked upon largely as of maximum benefit to the track structure. However, each blow that is transmitted to the rail by the locomotive sets up within that locomotive tremendous forces and vibrations which will be reflected in broken parts and failures, making necessary repairs which decrease the availability of the unit.

The designer must give serious consideration to the locomotive's lubrication problems and provide reliable accessibly located automatic lubrication devices which require a minimum amount of time to place in serviceable condition when attention is necessary.

The locomotive should be furnished with sufficient supplies, fuel and water so both freight and passenger schedules, which are being tightened continuously, can be consummated without undue delay.

It is also well for our friends among the specialty companies to bear in mind this item of utilization and design their equipment so that it will require a minimum of attention and be completely accessible when attention becomes necessary.

Long Locomotive Runs

Extended locomotive runs, in both passenger and freight service, have done more toward increasing utilization of the unit than any other single activity. The

success of long runs in passenger service where schedules are most exacting has been pronounced and it seems that a continued effort along these lines in connection with freight operations should pay handsome dividends. You are all familiar with the difficulties that we experience in endeavoring to lengthen freight-locomotive runs, but we should not allow these difficulties to deter us from continually striving toward that end. The longer freight-locomotive run is ofttimes interfered with by lack of fuel and water capacity, by operating delays incident to locomotive movements around terminals, by different classes of power interfering with the smooth engine-terminal performance, by the lack of air lines in yards and the resultant delay to road engines used for pumping train lines, and numerous similar conditions. Nevertheless, real cooperation between departments and an intelligent analysis of each individual situation will, I believe, bring results well worth the effort toward decreasing the amount of power necessary to move a given amount of traffic.

Attempts have been made to relay freight locomotives at many terminals in lieu of running them through such terminals, and while this provides improved utilization as compared with the former method of operation wherein each locomotive was sent to the enginehouse and placed in pool, such relaying is not as advantageous from the utilization standpoint as when the locomotives are operated through these terminals. Studies which we have made comparing the two methods of operation indicate that for every six trains operated by relaying locomotives, one additional locomotive each 24 hours is required over the operation of these units through the terminals. Coal and water facilities may be necessary at terminals in order to provide the necessary supplies for the through running movements.

Repairs

There is a very definite relationship between the utilization factor and the policy of the carrier with respect to locomotive repairs. Involved in this phase of the subject is that old question of the type of repairs which should be accomplished in the back shops. It is my belief that our back shops should be equipped with modern heavy tools in such a manner that heavy repairs can be accomplished in the minimum time, and it goes without saying that such back-shop repairs must be of the highest quality.

When the locomotive has been placed in service after shopping, it should be maintained until the next shopping period by means of periodic inspections. The length of time between periods and the activity at these inspections depends upon the class of power involved, its overall mileage between back-shop repairs, and the quality of the back-shop repairs and periodic inspections. Properly organized and policed power treated in this manner should run between periodic inspections with very little attention other than the necessary cleaning of fires, inspection, lubrication and washout requirements.

Water Treatment

During recent years there has been considerable progress in the methods for treating boiler feedwater which has resulted in decreasing boiler scale and sediment and thereby extending washout periods. We are, of course, required by the Interstate Commerce Commission to wash locomotive boilers every 30 days, but I believe it is not too optimistic to look forward to the time when boiler waters may be so treated that the locomotives may be given an opportunity to run for periods considerably in excess of 30 days without requiring a boiler wash. The geographic location of any particular carrier and the economics of water treatment, of course, enter into the possibilities to which I refer.

Surplus Power at the Enginehouse

Exceedingly valuable information pertaining to this subject can be developed by charting enginehouse performance for the different classes of power handled, basing such charts upon the arrival and departure time of each class of locomotives involved. The results obtained from studies of such charts would indicate quite definitely the normal turning time of any particular class of locomotives at the particular enginehouse. This normal turning time may vary during the days of the week because of fluctuations in business. However, the unit of turning time that is arrived at can be set up as a yard stick to measure the performance, and having developed such a yard stick it is necessary, of course, to follow the item from day to day with the enginehouse forces in order to be sure, on one hand, that a sufficient amount of power to protect the service is available, and, on the other hand, that surplus power is quickly stored.

Statistics

A review of the 1936 statistics as presented by the A.A.R. Committee on the Utilization of Locomotives indicates an average of approximately 260 miles per day in passenger service, 150 miles per day in freight serv-

"A. A. R. statistics on utilization of locomotives indicate an average of 260 miles per day in passenger service"

ice, and 15 hours per day in switching service as the most satisfactory utilization that is obtained by any of the larger American railroads. These figures, converted to monthly in lieu of daily performance, indicate 7,800 miles in passenger service, 4,500 miles in freight service and 2,700 miles in switching service. However, studies which have been made of individual types of locomotives have produced for the corresponding services 12,000, 7,500 and 3,000 miles per month, respectively.

When a locomotive runs 12,000 miles per month in passenger service, assuming an average speed of 45 m.p.h., it is earning revenue only nine hours per day and the remaining fifteen hours per day are spent at engine terminals either udergoing inspection and repairs or awaiting call. Similar calculations for freight service produce a working period of ten hours a day, and in switching service a working period of 16 hours a day. These figures indicate clearly that there is still considerable room for improvement from the standpoint of utilization of this expensive equipment. Studies of utilization for the seven-year period 1929 to 1936, inclusive, indicate that in both passenger and freight service there has been an approximate improvement in mileage per day of one per cent per year, this percentage referring to the entire group of American railroads and indicating clearly a trend in the right direction, although progress has been exceedingly slow. A study of the statistical information dealing with the utilization of power indicates that there is considerable room for improvement, and strict attention to design features, long engine runs, back-shop and periodic repairs, prompt handling and turning at terminals, and cooperative assistance between departments should assist materially toward improving this important feature of railroad operation.

The Influence of Higher Aesthetic Standards

Tendencies in changing attitudes of the public demand consideration

By Roy V. Wright

Editor, Railway Mechanical Engineer

We live in a wonderful country and a remarkable age. Advancing in a comparatively short time from a crude, pioneer stage in a territory of vast area and widely extended frontiers, and taking advantage of the marvelous developments of applied science in utilizing our natural resources, our people have achieved standards of material welfare far beyond the wildest imaginations of our great-great-grandfathers. In this respect we lead the rest of the world by a comfortable margin. As individuals, however, we are so deeply involved in the details of our own individual tasks or assignments that too frequently we fail to grasp the full significance of what is taking place in a large way; and yet, as men engaged in a fundamental and vital activity we cannot afford to overlook changes which are constantly taking place in public attitudes or likings and which may severely react upon the fortunes of the railroads, if they are not promptly recognized and capitalized upon.

Objectionable Smoke and Noise

We, as railroad men, take a keen pride in the locomotive, with its tremendous power and its ruggedness. To most of us the steam locomotive is a thing of real beauty, and in this attitude great numbers of non-railroaders are in hearty accord. On the other hand, the steam locomotive, particularly when coal-fired, gives offense to many people because of the smoke and dirt which are characteristic of its operation and its periods of idleness in terminals. It must be admitted that substantial progress has been made in the past decade in reducing the amount of black smoke which is showered over our communities. And yet, unfortunately, there still remains much which we must admit is open to criticism and which gives offense to members of the community, whose good will is sorely needed in these days.

Electrification of a few railroads in metropolitan centers has been helpful in eliminating or reducing these nuisances, and yet, within the week I have seen a through passenger train, drawn by a steam locomotive, which was belching out great clouds of dense, black smoke in the center of a high grade residential community—and this on a road which proudly boasts of its electrically operated suburban trains in the same district. I saw a realtor swear under his breath as he witnessed this desecration. With some considerable feeling he remarked, "They don't seem to give any attention to the smoke nuisance from steam locomotives operating their freight trains and their through passenger trains, since they have electrified their suburban service."

Steam Locomotives Still Going Strong

I realize that many people firmly believe that the steam locomotive is on the way out and that we will not much longer be subjected to these nuisances. We, as railroad men, however, know that this is not true and that we will continue to have to deal with the steam locomotive for a long time to come. Some of you recall that thirty-odd years ago certain people were prophesying with considerable confidence that the steam locomotive would be replaced by the electric locomotive within 10 years of that time, but the "old reliable" still remains with us. Proponents of the Diesel engine are today almost equally enthusiastic in their claims. Possibly some of you may have read the section on transportation in the report on Technological Trends and National Policy which was recently made to the National Resources Committee. Here are some extracts from it:

"Looking forward to a freight traffic increasing only slowly, at best, beyond the 1926-28 levels, the bulk of railroad freight will be hauled by steam locomotives."

Another sentence in the report reads: "The steam locomotive will likely prove adequate to the general demands of the railroads in the next 20 years, and in the field of passenger traffic will help to bring to the rails a good share of the business now hauled by other agencies."

That the designers and builders have not been standing still is indicated by the following quotation from the same report: "Few types of machinery have been so greatly improved in the past 20 years as steam locomotives. Weight per horsepower has been cut in half and

the thermal efficiency doubled. Progress in the future will undoubtedly continue. Higher boiler pressures, higher steam temperatures, greater fuel economy, greater steam capacity, better steam distribution, ability to make longer runs and greater mileage between shoppings—in all these and many other ways the steam locomotive is being so radically improved that comparatively few people realize the superiority of today's locomotive over engines built 15 or 20 years ago."

Yes, the steam locomotive promises to remain with us for a long time to come, and even where it is displaced we shall have to reckon with the elimination of obnoxious odors, gases and noise from the Diesel engines. A large hotel, not far distant, complains more about smoke and the oil film on its windows caused by Diesel engine exhausts than it did about smoke and dirt from steam switchers.

Why All the Argument?

But, you say, "Why all this argument? Is it not true that we have made excellent progress in smoke reduction in recent years? What is all the fuss and feathers about?"

My answer is this. Public appreciation of the finer things of life has advanced at an even more rapid rate. Take the item of dress, for instance. When I was a boy the styles in a midwestern city trailed behind those of the East by a year or more. Today, the farmer's daughter in remote sections of the country, wears the same styles as does the girl on Broadway in New York. Not so many years ago crackers were ladled out of a barrel at the grocery store and the loaf of bread was stark naked. Today, even ordinary crackers are handed to us over the counter in highly attractive and artistic, sealed packages, and the loaf of bread is attractively wrapped in cellophane and sliced, ready to serve.

Art in Industry

The expression "art in industry" is becoming quite commonplace. The Metropolitan Museum of Art of New York City maintains a director of industrial relations, who gives his time to making the museum collections of practical value to the manufacturer, the designer and the trade press. Many of our grade and high schools have courses in art appreciation and it is fascinating to see the rather high standard of taste of the average student, even in the very young groups.

"The bulk of freight will be hauled by steam locomotives"

Store window dressing and the display of goods on the shelves and counters is now in the hands of experts and has become more or less of an art. Tea rooms, gasoline service stations, hotels, restaurants, theatres, movie houses and stores vie with each other to provide artistic and comfortable surroundings and services. Incidentally, competitors of the railroads are not far behind in these respects.

Even the builders of machine tools and other machinery recognize the importance of artistic and well-shaped models; possibly the automobile, in the effort to develop sales appeal, has been a stimulant in this direction. At any rate, a machine with a shapely and artistic appearance gives the impression of efficient and effective operation, which is lacking in a design which presents a cruder appearance, even though it may be just as strong and efficient.

A few years ago I had occasion to visit the engineering school of Montana State College at Bozeman. At the end of a two-day visit in mid-winter, I went to the railroad station to take a train East. A few passengers huddled around the coal stove in the center of the room, waiting patiently for the train. Suddenly the door burst open and one of the engineering students rushed in. He handed me some information that I had requested the day before and apologized for the last-minute delivery by saying that he had been tied up during the day with one of his examinations—a course in art appreciation. I expressed surprise that a mechanical engineer was taking such a course, suggesting that in my day the cinch course for easy credits at the university was psychology, and that I presumed the course on art appreciation was in much the same category today.

"Not on your life," replied the student. "It is the hardest course I am carrying." Questioning developed the fact that the head of the Department of Mechanical Engineering was quite insistent that his students take this course, since he felt that it was of vital importance for a mechanical engineer to be so equipped.

Railroads Not Asleep

Quite rightly you can counter these statements and insist that the railroads have not been asleep. They, too, have employed artists and experts to assist in making more attractive the passenger equipment, even to the extent of de luxe furnishings in day coaches. Encouraged by the reception accorded the introduction of the high-speed, streamlined trains, and fearful of the continued inroads of other types of common carriers on the passenger traffic, they have done much to improve the comfort and convenience of their services. Incidentally, one of the most important results of the advent of air conditioning has been the exclusion of dirt from the interiors of passenger cars. These improvements have been greatly appreciated by the traveling public and are helping to bring business back to the rails. In spite of all this, however, it must be admitted that the railroads are still responsible for a considerable amount of unnecessary dirt and noise which irritates the general public on whose good will their welfare depends.

What Can Be Done?

What can be done about it? I have followed rather closely and critically an experiment which has been conducted in Hudson County, N. J., during the past six years. It was inspired by Stevens Institute of Technology at Hoboken. In 1930 Col. E. H. Whitlock was

called from Cleveland, Ohio, where he had served so acceptably for several years as commissioner of the Division of Smoke Inspection, to take the chair at Stevens of research professor of smoke abatement.

The authorities of Hudson County were approached to co-operate in this movement. A Department of Smoke Regulation was set up as a part of the Board of Health and Vital Statistics of that county, and William G. Christy, who had helped to organize the Citizens Smoke Abatement League of St. Louis, was appointed smoke abatement engineer in December, 1930.

Hudson County, on the banks of the Hudson River, opposite lower New York City, is the rail terminus of a number of railroads serving New York City; it is an important industrial center as well. As one of the first steps, the operating heads of these railroads were approached; smoke from the locomotives and the terminals was admittedly a serious problem. It was pointed out, however, that the density of the smoke was a measure of the inefficiency of the use of fuel and little difficulty was experienced in securing the interest of the railroad officers when it was indicated that it was intended to inaugurate a campaign of education, which would not necessarily involve any great amount of expense, and that this might be largely offset by the resulting savings in fuel.

Railroad Smoke Association Organized

The Railroad Smoke Association of Hudson County was organized early in 1931 and holds monthly meetings. Addresses are made by members or outsiders who are specially qualified, and reports are prepared and discussed by the members. The program of the Department of Smoke Regulation calls for about 850 observations of smoke from locomotive stacks per month, the density being based on the Ringelmann chart. During 1931, the first year of operation, 6,761 readings were made; since that time the number each year has exceeded 10,000.

Reports are regularly issued by the department, showing the results each month, the nine railroads being listed in the order of merit of their performances. During 1936 two of the roads averaged a smoke density of less than one per cent, a most excellent performance. The highest average for the road at the bottom of the list was 2.637, while the average of all the readings taken for all the roads was 1.657. This compared with 16.03 for the first year of operation of the department in 1931; with 5.20 for the second year, and with 3.45 for 1933, the third year.

In securing these results attention and study were given to all of the factors concerned with the efficient use of fuel. Naturally the human element was of first importance and steps were taken to insure careful checking and coaching of the engineman. You can readily understand how the study and discussion of this problem by the Railroad Smoke Association proved fruitful of results.

In some instances it developed that more attention had to be given to the proper kind of fuel to use and the supplying of uniform grades of fuel. It was also necessary in certain cases to give more attention to the condition of the power and to make detail changes in the locomotive design. These and many other related problems were developed in the meetings of the Railroad Smoke Association and with the cooperation of the Department of Smoke Regulation. Some idea of the interest in the activities of this association may be gained from the fact that the average attendance at its monthly meetings last year was about sixty.

Approaches to Cities

We are familiar with the activity of local chambers of commerce and service clubs in boosting and advertising the advantages of their communities. On the other hand, the approaches to most cities by railroad, at least, are through drab and dingy surroundings. The railroads are, of course, to a degree responsible because of the dirt and noise involved in the operation of passing trains. With cleaner and quieter operation and with the dressing up of their own properties, they are less to blame for this condition. With the practical elimination of smoke from locomotives and engine terminals—and this is possible, as has been proved in many cases—pressure can well be exerted on property owners along the right-of-way to do their part in making the approaches to the community more attractive. All of this will undoubtedly prove so much to the advantage of the railroads that they can well afford to assume the leadership by reducing the smoke and noise in train operation and in making their properties more attractive.

Returning to my original thesis. We are coming into a new day. The break will not be sharp; indeed, we have been traveling steadily in the direction for many

* * *

The New Haven "Comet" at Readville, Mass.

years. The artistic instincts of the public will be more and more offended unless locomotive smoke is practically eliminated. Unless we improve on our present practices we will surely be forced by legislation, or otherwise, to take steps that may prove extremely expensive, but which can readily be avoided if we courageously and persistently strive to minimize these evils as rapidly as possible, with the objective of eventually removing them entirely.

Smoke from locomotives is tangible evidence of wasteful operation. Your organization has always been a leader in the field of the efficient use of fuel and in smoke abatement. I beseech you not to relinquish your efforts in this direction.

Report on Fuel Records and Statistics

Trends in unit fuel consumption and various factors in train performance

During the year 1936 the locomotives of the Class I railways of the United States consumed fuel and power equivalent to a total of 97,732,494 tons of locomotive coal, at an average charge out price of $2.59 per ton, which involved a total cost of $252,821,000.00 and represented the expenditure for locomotive fuel and power of 6.2 cents out of every dollar of operating revenue earned.

These are very impressive quantities even in these billion dollar days. It is impossible to over stress the importance of the effect upon operating results that follows from the reductions in this heavy item of expense that are being made now and that have been made in comparison with the expenditures of past years.

Your committee therefore has felt that a brief presentation of the results gradually accomplished in this direction over the short period of the past ten years would be appropriate as a matter of interesting information and as a measure of stimulation toward still further gains in the future.

As compared with the year 1926, the Class I railways in 1936, by reducing the unit consumption of fuel in the three classes of service—passenger, freight and yard switching—saved fuel to the equivalent of 12,351,560 tons of coal with a total value of $31,990,540.00. This is equivalent to 12.6 per cent of the total expenditure for locomotive fuel for the year 1936; see Table I.

The freight service alone contributed 24 million dollars to this total through the 13 per cent reduction in the unit consumption of coal per 1,000 gross ton miles from 137 in 1926 to 119 in 1936.

Table I—Reduction in Unit Fuel Consumption

	1926	1936	Value of saving, 1936 vs. 1926
Passenger, lbs. per p.t.c.m.	15.8	15.3	$1,840,187
Freight, lb. per 1,000 g.t.m.	137.0	119.0	23,999,818
Yard switch, lb. per yard-engine hr.	822.0	706.0	6,150,535
Total			$31,990,540

It is our purpose in this report to emphasize:

First. The changes that have occured in the freight service performance of the larger individual Class I railways, in the ten year period just passed in comparison with the changes in the operating factors that are considered to be most closely involved with fuel performance, and

Second. To show graphically the year by year progress of the changes in the relationships between: (a) Fuel performance and engine load; (b) fuel performance and speed of movement; (c) fuel performance and gross ton miles per hour; as these changes in relationships are displayed by the annual averages for the Class I railways as a whole.

The 1936-1926 comparison of the factors that are significant in freight service fuel performance for 45 Class I roads, each of which made two billion or more net ton miles in the year 1936 is of interest. For this ten year period the percentage of change in unit fuel consumption for the 45 roads in the table ranges from a decrease of over 29 per cent to an increase of about 6 per cent with the average of the Class I railways showing a decrease of 13.15 per cent.

For these 45 roads the comparative change in this ten year period in average engine load, gross ton miles per locomotive mile, ranged from an increase of 68.4 per cent to a decrease of 21.1 per cent, with the average of the Class I railways showing an increase of 6.5 per cent. It is noticeable that in general, the largest percentages of increase in engine load are associated with the largest percentages of decrease in unit fuel consumption, and as indicated by the averages for the Class I railways as a whole, notwithstanding the 32.8 per cent increase in speed of movement, each increase of one per cent in engine load has been accompanied by a decrease of two per cent in the unit consumption of fuel.

The average weight of locomotive used, gross ton miles of locomotive and tender per locomotive mile, increased 17.5 per cent from 206 tons in 1926 to 242 tons in 1936.

The average speed of movement, train miles per train hour, increased 32.8 per cent from 11.9 m.p.h. in 1926 to 15.8 m.p.h. in 1936.

The average gross ton miles per hour increased 41 per cent in the ten year period.

Additional light is thrown upon this relationship between engine load and unit fuel consumption when further study is given the yearly averages of the Class I railways over a period; see Table II.

A contrast in value that is both interesting and instructive may be observed by setting up a comparison between the average for the first seven years and the second seven years of this fourteen year period. It may be observed that during the latter period a 5 per cent higher engine load was handled at a 27 per cent higher speed with a 13 per cent reduction in the unit fuel consumption.

Table II—Engine Load and Unit Fuel Consumption Class I Railways 1923 to 1936 Incl. Freight Service

	Pounds coal per 1000 g.t.m., incl. loco. & t.		Engine load, trailing		Speed, miles per hour		Gross ton-miles per hour	
Year	Fuel unit	Per cent increase vs. 1923	Tons	Per cent increase vs. 1923	M.p.h.	Per cent increase vs. 1923	Value	Per cent increase vs. 1923
1923	161	....	1360	....	10.9	....	16,764	...
1924	149	7.46	1417	4.19	11.5	5.50	18,261	8.9
1925	140	13.05	1485	9.20	11.8	8.25	19,685	17.4
1926	137	14.90	1540	13.20	11.9	9.15	20,705	23.5
1927	131	18.65	1577	15.95	12.3	12.85	21,940	30.8
1928	127	21.10	1624	19.40	12.9	18.35	23,652	41.0
1929	125	22.40	1650	21.30	13.2	21.10	24,539	46.3
1930	121	24.85	1665	22.42	13.8	26.60	25,843	54.1
1931	119	26.10	1625	19.45	14.8	35.80	26,721	59.4
1932	123	23.60	1525	12.12	15.5	42.20	26,064	55.5
1933	121	24.85	1570	15.45	15.7	44.00	27,344	63.1
1934	122	24.20	1585	16.55	15.9	45.80	28,041	67.3
1935	120	25.45	1604	17.95	16.0	46.80	28,674	71.0
1936	119	26.10	1640	20.60	15.8	45.00	29,186	74.2

According to calculation considered to be conservative, if other factors had remained unchanged, the increase in average speed would have resulted in an increase in unit fuel consumption of 15 per cent. It is evident therefore that other factors did not remain unchanged, but that measures not disclosed by the statistics were adopted that more than offset the increase in unit fuel consumption that was to have been expected and produced instead a decrease of almost equal proportion. The increase of 5 per cent in the average engine load undoubtedly had quite a favorable effect and it is probable that some of the measures adopted that were favorable to increased engine load and to improved fuel performance might be identified as the elimination of some proportion of expensive service and the more extensive use of heavier locomotives, some part of which were of modern design and improved construction.

When graphical representation is made of the data shown in Table 2, it appears to be definitely indicated that there is a consistently close correspondence between the increase in engine load and the decrease in unit fuel consumption. This correspondence is evident both upon the basis of the actual values year by year and upon the basis of the percentage of change in the values for each year from the values for 1923 considered as a base.

While undoubtedly many other factors enter into this relationship and affect it vitally there appears to be no doubt that increasing the average engine load, and the measures that have made it feasible, have been the dominant factors in the decreasing unit fuel consumption.

An abrupt break is noticeable in the conformity of the charted relationships in the year 1930, after which the comparisons appear to have become established upon a different plane from that which obtained up to January 1, 1929.

The increasing average speed of movement has had a disturbing and distorting influence upon the normal relationship between average engine load and unit fuel consumption, particularly so in the years since 1929, during which such large increments of speed have been added to the averages, while the engine load has decreased and the unit fuel consumption, after reaching the low of 119 lb. of coal per 1,000 gross ton miles for the year 1931, has fluctuated above that value for four years and only returned to it in 1936 with the decided increase in engine load obtained during that year.

A chart showing the relationship between unit fuel consumption and speed pictures the adverse influence of the increased average speed for the years since 1931. This increase in average speed has been accompanied by the decrease in average engine load, the combination which has exercised the strongest possible influence toward increased unit fuel consumption.

A chart showing the relationship between gross ton miles per hour and unit fuel consumption, displays also the effect of the disturbing influences that have obtained during the period of subnormal business volume.

In conclusion, it appears that the conditions surrounding the competition between lines for the business available and the high standard of service demanded by shippers and now firmly established by the railroads, indicate unmistakably that the higher average speed of movement is a condition that must be accepted as permanent. The fact that it penalizes fuel performance must be accepted and the only practicable offset is the utilization of a greater percentage of locomotives designed and constructed to move economically heavier trains at high speed.

The report was read by Chairman E. E. Ramey, B. & O.

Discussion

The general theme of the discussion following this report was to the effect that too few fuel records and statistics is likely to cost the railroads even more than the opposite extreme of too many fuel records and statistics. In other words, a happy medium should be chosen which will give railway managements sufficient information regarding fuel trends to know what is actually being accomplished and enable them to apply corrective measures promptly where necessary.

To illustrate what can be accomplished in the way of quick action, the experience of the Southern Pacific was cited, this road having recently established an extensive section of test track which is used for obtaining a rough check of locomotive fuel performance in passenger service. Locomotives of a given class and with a uniform train load are operated over this test track daily and sufficient clerical help has been employed to record the engineman's reports of fuel oil consumption between various points on the run. These fuel consumption figures are telegraphed ahead to the clerk who is able to detect immediately any locomotive which may be using too much fuel, due to worn cylinder packing, a leaky superheater unit or improper firing conditions. The operating department is notified and if necessary, the locomotive is taken out of service for repairs before the completion of the run.

Report on the Utilization of Coal

Suggestions for further reductions in the unit cost of fuel

(Detailed information included in this report regarding the proper inspection and preparation of coal is of great importance to the railroads, but may be considered the specialized interest of the relatively small group of fuel men responsible for these details. The present abstract of the committee's report will be devoted to the third section on Utilization of Coal.—Editor)

a—Have any studies been made by your company as to the cost of fuel per 1000 ton-miles, as distinguished, from unit performance in pounds per 1000 gross ton-miles?—Answer: Yes, for 12 of 13 replies. No, for 1 of 13 replies.

b—Do you consider the above study of practical value?—Answer: Yes, for 10 to 13 replies. No, for 2 of 13 replies. No, from a fuel conservation standpoint, for 1 of 13 replies.

c—Do you keep a record of terminal or roundhouse fuel consumption? If so, how is this done?—Answer: 9 state no record kept. 3 state periodical checks, occasional checks, or checks at various times are made. One states estimate made at time of each coaling by operator of coal pocket.

d—Have increased train speeds, long engine runs, and less standing time had any effect on the grade and preparation of coal required for locomotive use? What is the effect?—Answer: 5 state no change has been re-

quired. Of the remaining 8, each is quoted as follows:

"Yes. It has required coal of good quality and good preparation for use at important terminals on the high speed engines."

"Yes, we have to have a better grade for long, fast runs in order to cut out fire cleaning."

"On long engine runs, it is desirable to furnish a good grade of coal, in order to avoid long delays at intermediate terminals on account of fire cleaning."

"These changes have necessitated to some extent a better grade and preparation of fuel for fast passenger service. However, we have not found it necessary to change preparation or grade of coal to any extent on our freight locomotives with the increase in train speeds and long runs."

"The increasing demands on locomotive performance occasioned by increased train speeds, longer trains, shorter turns, etc., have intensified the necessity of using a good grade of coal and this has brought about the rejection of certain inferior grades of coal formerly purchased."

"Yes, exhaustive tests proved conclusively that a higher grade of coal with a lower ash content was necessary in order to prevent delays enroute cleaning fires, dumping ashpans, etc."

"Yes, requires coal of higher quality, lower in ash, and more uniform in size."

"Yes, this has necessitated using a much cleaner grade of coal."

How Reduce Unit Fuel Cost?

e—What can be done, in your opinion, to reduce the cost of fuel per car mile, or per 1000 gross ton miles?—Answer: All answers are quoted in order, as follows:

"Because of its ramifications this is not a question to be answered in a few words. A great deal depends on the expenditure necessary in the purchase of fuel, as a good fuel performance from the standpoint of the pounds consumed per unit of service would not necessarily mean a good cost per unit as that would depend largely on the price of the fuel."

"Maintenance — longer runs — determine and use proper size and grade of coal—efficient engine operation."

"Keep the power in first class condition at all times and supervision enough to see that the best practice in handling and firing the engine prevails at all times, including train and yard movements."

"Furnish the particular fuel which has proved most economical and suitable for use in the various classes of service. Study all factors that affect the full consumption rate, with a view of eliminating inefficiencies as far as possible.

"In all production activities the volume of production vitally affects the unit cost of production and the production of transportation by the railroads is no different in this respect from other production activities. Increasing volume of business tends automatically to reduce all railroad operating unit costs, including unit fuel costs and the present trend of business volume is favorable to that end. In opposition to this favorable factor are the rising costs of all the detail elements that combine to establish the gross operating expense of the railroads. These can be offset only by gradual improvement in the physical plant including the rolling equipment and the permanent way and the facilities provided for their maintenance, supplemented by improved operating methods through which the most effectiveness of the plant may be realized. Among the necessary improvements prominent position must be assigned to the gradual replacement of obsolete power with locomotives of modern design, adapted to the existing conditions of operation and those to be immediately anticipated. Reduction in the unit cost of fuel along with reduction in the other unit costs, will be influenced to a greater extent by these necessary fundamental improvements than by any secondary supplemental measures that are practicable.

Systematic Supervision over Details Is Essential

"However, this fact does not by any means detract from the value of systematic supervision over the details that affect economical use of the fuel under a given operating set-up. It is considered that the principal features in the order of their importance are about as follows:

"1—A high standard of maintenance of the operative condition of the locomotive.

"2—Instruction and supervision of the enginemen and firemen.

"3—Instruction and supervision of the engine terminal employes.

"4—Systematic distribution of fuel to coaling stations and adequate inspection service to maintain standards of quality and grade of fuel.

"5—Adequate, accurate and promptly available sta-

* * *

tistical records of performance for the information of all concerned."

"By carefully watching the fuel consumption on the different types of power with the class of service such power is used. Study the length of time that a locomotive should be held under steam at terminals to determine the economical period in which fires should be dumped."

"We believe that is still an opportunity to reduce full costs by the following methods:

"Keep locomotives in good serviceable condition.

"Supervision of the handling by both the engineer and fireman essential.

"Reduce cost of fuel for firing up, allowing only time enough to get the engine ready after the call. Direct steaming of engines will make a big improvement where possible to obtain this facility.

"Should insist on best preparation of the coal. There are also many other factors that need consistent supervision, with the detail of which you are familiar. We have made a study in yards of how many hours a yard engine should be working in order to get best results. We find that 16 hrs. out of 24 hrs. should be worked either straight through or staggered. Say, 8 hrs. from 8 a. m. to 4 p. m. then back into service at 12 midnight to 8 a. m. This will cut fuel costs in yard service."

"Continued education of terminal forces to fire up locomotives on shortest time possible to fill orders on time for the yard.

"Make frequent tests to insure proper cleaning of flues, maintaining feed-water heaters and leaks in front ends, grates, brick arches as well as maintaining valve gears and other parts of locomotives in best serviceable condition.

"Co-operation from the transportation department to reduce the time of locomotives laying in the yards waiting for the trains to a minimum, also prompt movement of the locomotives to the engine terminals after completion of trip.

"Proper education of terminal forces on fire cleaning, firing up and banking of fires on locomotives not dumped, overloading of tanks, proper use of blowers, and the practice of having air pumps, generators, etc., shut off when the locomotive is at rest."

"The cost of fuel per unit of volume can be reduced by:

"a—Use of proved appliances which improve boiler performance and efficiency.

"b—Instruction and supervision of engine and terminal forces as to efficient and economical use of fuel.

"c—Replacement of obsolete and uneconomical locomotives with modern equipment.

"d—Insistence upon the use of a good grade of coal."

"Continued supervision of all factors pertaining to fuel waste as outlined by previous proceedings of the International Railway Fuel Association.

"Experience would indicate that when selecting a locomotive coal, inspection and analysis should not be entirely depended on, but in addition the coal in question should be actually tried out on the locomotive to determine whether or not it meets the requirements of the individual railroad.

"Railroads that are located great distances from the coal mining regions where freight rates per ton amount to considerably more than the cost per ton at the mines, must necessarily be very careful in selecting the grade of coal that is not only suitable for the service demands, but is suitable from the unit cost standpoint."

"Keeping locomotives in good serviceable condition, adequate and careful supervision in work of fuel economy in all its phases, of which all of us are familiar including a check of train operations, consist, speed, etc."

"Maintain interest in the work of fuel economy."

"More rigid inspection, careful attention to distribution, more rigid specifications. Education of officials and employes along fuel economy lines. Supervision of crews. Extension of locomotive runs wherever facilities are suitable or can be made so."

"Using as far as practicable and economical, smaller sizes and lower-priced coal on stoker-fired locomotives, without lessening efforts to keep consumption at a minimum by stimulating interest in fuel conservation, longer engine runs, reduced time and fuel consumption at terminals, a high standard of maintenance, modernizing power, and reducing train delays to a minimum."

The report was signed by Chairman W. R. Sugg, supt., fuel conservation, M. P.

Valve Motion and Its Effect on Fuel Economy

Report advocates more mechanical training for firemen to insure intelligent work reports

Last year your committee in presenting its paper on this subject called to the attention of this association several pertinent reasons for paying closer attention to valve motion. It was not the intention, however, to recommend a standard setting for either passenger or freight locomotives, but rather to urge a standard of maintenance when once the setting was decided upon that would insure better locomotive performance at lower maintenance cost.

It was also pointed out last year that many young men would soon be employed to fill the present dwindling ranks of veterans. This transition is now taking place, and we feel that now is the time to begin the education of the rising generation of both operating and maintenance forces.

We believe that now is the time to insist candidates for employment and promotion be educated to a degree that study of mechanics and locomotive operation will not be irksome, and the information laid down in mechanical books pertaining to the care of the locomotive boiler and engine can be readily understood by everyone.

Marine engineers serve an apprenticeship while firing, they must acquire a thorough knowledge of the construction and operation of all the machinery under their charge, and finally are required to pass an examination before a marine board to prove their fitness for the position. Why should locomotive firemen not be required to pass a somewhat similar examination?

Were this the case, then the care of valve motion would receive closer attention, as those reporting defects would be better equipped properly to report the trouble, thus saving many hours of needless work at considerable expense by mechanics at repair points. Then if the defects are due to improper steam distribution, a standard system of correction should be followed at all repair points on the system. This is not now the case on many railroads.

A thorough understanding of valve motion by the locomotive operator and maintenance force will tend to promote a better appreciation of economies that affect the

cost of locomotive operation, such as the elimination of an extra stop for water or coal, or that more tons of freight may be moved at higher speed, without increasing the fuel consumption.

Properly maintained valve motion also tends to reduce rod and driving box maintenance, and makes a smoother running engine.

It is also expected a better understanding of valve motion will promote more economical engine running, especially on railroads that have no mechanical means of showing individual locomotive performance.

The price of fuel is steadily advancing, as is the cost of labor and machinery, in fact, all railroad supplies are steadily advancing, while the cost of the commodity sold by them (transportation) seems to be stationary or retreating, therefore, it behooves closer attention by mechanical men to the heart of the locomotive, which, like the heart of man, is the most delicate and most important part of the machine, and also probably the least understood, and when out of tune is the most costly to both man and machine. A better understanding of which will not only prolong life, but pay handsome dividends through fuel savings and lowered maintenance costs. The report was signed by Chairman M. F. Brown, N. P.

Discussion

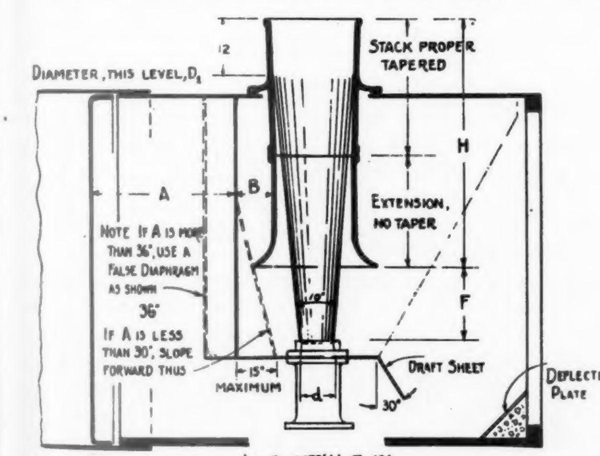
At the conclusion of Mr. Brown's report, the problem of how to keep valve motion square was briefly discussed. One speaker told of the trouble his road had with a series of locomotives because the reverse gear was not heavy enough to prevent the valve gear from creeping. The reverse gear was redesigned to eliminate this trouble. Since valve motion is the controlling factor in proper steam distribution, it was recommended that more indicator cards should be taken to check valve-motion performance.

Front Ends, Grates and Ashpans

Review of Mechanical Division report and descriptions of new front ends

Your Committee on Front Ends, Grates and Ashpans submits its report in three parts as follows:

On December 27, 1935, the Mechanical Advisory Committee, consisting of Messrs. L. K. Sillcox, F. W. Hankins, F. H. Hardin, John Purcell, C. J. Bodemer and W. J. Patterson, submitted to Joseph B. Eastman, then federal coordinator of transportation a report, consisting of a 700-page volume, which covered a wide range of subjects connected with railway rolling-stock and related matters. From the first section of this report, discussing the steam locomotive, we have copied verbatim those paragraphs representing the considered opinion of this distinguished advisory committee on those matters with which your committee is concerned. We have done this as a means of placing before a large group of railway men, directly concerned with the topics discussed, this material which might not otherwise be available to them.



$d = D_1 - 0.175(H + F - 12)$

Fig. 1—Suggested diaphragm arrangements with Master Mechanics' front end

At the meeting in Chicago in June, 1936, the Committee on Locomotive Construction of the Mechanical Division of the A.A.R. presented, as part of its report, the report of a Subcommittee on Front-End Arrangements. We have made a very brief digest of this latter report, which virtually establishes a new Master Mechanics' front end, in order that we may make certain comments and criticisms on the proposals, and that this convention may have a similar opportunity to comment upon and to discuss this report.

We have made brief notes on such new or recently modified appliances within the field of this committee as have come to our attention since the last report was made. These are two in number only: the Coffin Superdraft arrangement, and the modifications which have been made in the Cyclone spark arrester.

Paragraphs from the Report of the Mechanical Advisory Committee

The following paragraphs of this section are verbatim quotation from the Advisory Committee's report.

Stack Proportions—It is reasonable to assume that the relative areas of smokestack and steam jet have an important bearing on the degree of efficiency since, for equal displacements, a small smokestack must necessarily entail a higher velocity of the gases than a large one. The efficiency, when measured in back pressure horsepower as compared with the weight of gas discharged therefore, will be lower under the former than the latter conditions. Also, since, by reason of its loss of pressure after leaving the nozzle, the jet of steam is expanding, the cross-sectional area of the stack should be increased upward, thereby avoiding a restriction in the area of the flow. The gases may contract during contact, and partially mingle with the cooler steam, but, on the other hand, this will increase the expansion of the steam, and every facility should be provided for allowing the steam to freely expand, thus converting its static into kinetic energy while it is still in contact with the gases in the smokestack. Likewise, the cross-sectional area must be enlarged to the point where the gases will not normally fill the stack.

Front-End Designs—Since one function of the front-end arrangement is that of intercepting cinders, delaying their passage through the stack until all fire is extinguished and they are relatively cool, some resistance must, of necessity, be introduced into the smokebox,

whether in the form of netting, through which all exhaust gases must pass or in the form of a longer path. The Master Mechanics' front end was used almost exclusively for many years and was considered entirely satisfactory, such difficulties as were experienced and losses suffered being accepted as unavoidable in view of the functions to be satisfied. The front-end problem has been attacked with renewed vigor in recent years, and the Master Mechanics' arrangement of netting and baffles is giving way to several improved designs which offer more in spark protection, accessibility, simplicity, reduced maintenance, or lower resistance to the passage of the products of combustion.

Digest of the Mechanical Division Report

The conclusions and recommendations of this subcommittee are summarized in the nine paragraphs which follow:

Gas Areas—The successive areas through which the gases pass should be proportioned as follows. If 100 per cent represent the net gas area through the tubes and flues, the corresponding areas of other gas passages should be approximately 115 per cent over arch, 95 per cent gross area under table plate, 85 per cent minimum net area under table plate, deducting nozzle stand, etc.; 75 per cent under draft sheet, 130 per cent net area through netting and 25 per cent minimum area of stack.

Stack—The minimum diameter of the stack should be the value in even inches corresponding to the area nearest 25 per cent of the net area through tubes and flues. The stack proper should have a taper ranging from 1 in 12 to 1 in 15 and should be 30 in. high if possible. The extension should be straight, with a wide flare, and should extend down to 15 or 16 in. above the top of the nozzle.

Exhaust Stand—The exhaust stand should be rectangular in section and should have a dividing wall extending up 8 or 9 in. to prevent blow-over.

Blower—The ring-type blower is the most economical.

Draft Sheet—The draft sheet should normally be inclined 30 deg. from the vertical; it should fit up neatly against the sides of the smokebox with its front edge exactly horizontal.

Deflecting Plate—The use of a deflecting plate at the front of the smokebox at the bottom is advisable, both to protect the front of the boiler and to prevent the accumulation of cinders in the corner.

Nozzle—The diameter of the nozzle should be determined from that of the stack on the assumption that the steam jet spreads at an angle of 10 deg. (5 deg. each side of the vertical axis) and that the jet come into contact with the stack wall at least one foot below the top of the stack. Thus, if dimensions are designated as in Fig. 1, the tangent of the 5-deg. angle being 0.0875, the diameter of the nozzle d is given by the formula:

$$d = D_1 - 0.175\ (H + F - 12)$$

The use of a cross spreader for the steam jet is recommended.

Diaphragm—If the space between the tube sheet and the diaphragm is greater than 36 in. a false diaphragm should be installed behind the regular diaphragm to reduce the volume; the space between the two diaphragms should be air-tight. If the space between tube-sheet and diaphragm is less than 30 in., the lower portion of the diaphragm should be sloped forward and should meet the table plate as near the exhaust stand as possible, except that the bottom of the diaphragm should not be more than 15 in. ahead of the top. If B is excessive, a false diaphragm may also be an advantage on similar engines. See Fig. 1.

Obstructions in Gas Passages—All pipes and other obstructions in the gas passage under the table plate should be gotten rid of if possible, even to the extent of redesign of the main steam pipes, and placing auxiliary outside of the front end.

Comment on the Report

Your committee believes that some of the terms used in the report vary from those which have been generally used and consequently presents Fig. 1, which

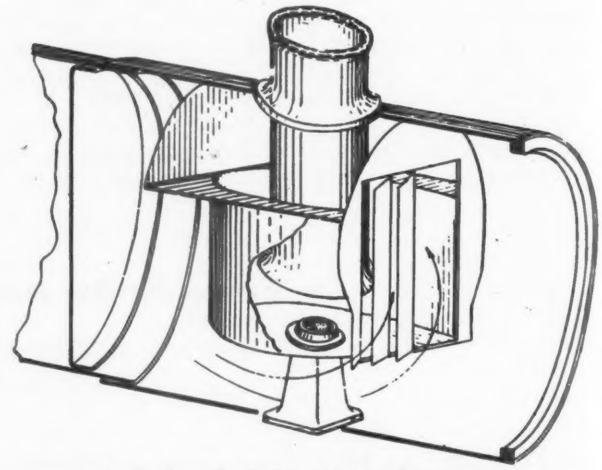


Fig. 2—Type-B Cyclone front-end arrangement

gives names of parts as used in the report where there can be any doubt as to their meaning. This figure also indicates the suggested diaphragm arrangements and the geometry of the exhaust nozzle design.

With respect to paragraphs on the exhaust stand, the blower, deflecting plate, and obstructions in the gas passages, your committee is in full accord. As regards the removal of obstructions from the gas passages, we believe this to be much more important than is generally realized.

With respect to gas areas, the Front-End Committee sets up a logical basis for design, except that the relation between the stack area and that of the tubes is rather indefinite. The report permits a variation in stack area of from 23 to 27 per cent of the fire area through the tubes; this would represent as much as 2 in. difference in stack diameter for some values of gas area.

With respect to the stack form, we offer no criticism but call attention to the fact that the influence of the form of the flare is debatable. The Pennsylvania front-end tests as reported in their Bulletin No. 9 many years ago demonstrated that the slightly diverging flare was extremely effective. The distance F should approximate the stack diameter, rather than be fixed at 15 or 16 in.

With regard to the draft sheet, the inclination of 45 deg. from the vertical and a slight lengthening of the sheet would result in an equal gas velocity and at the same time reduce the turbulence of flow around the lower edge of the sheet. There is enough eddy effect about the lower edge of this sheet, even under the best conditions, to produce an effect which substantially reduces the effective area of flow.

The paragraph on the nozzle is open to serious objection. The steam jet does not follow the course indicated by the proposed method of design; for its form is affected as soon as it comes into contact with the gas, and even more after it enters the range of influence of the stack. There is in the report no indication as to whether the use of the spreader requires a change in nozzle diameter. The proposed method of design results in a variation in diameter which is definitely con-

trary to known results; the greater the distance from the top of the stack to the top of the nozzle $(F + H)$, the smaller becomes the diameter; this is exactly the reverse of actual requirements.

As regards diaphragms, a suggestion for the use of the false diaphragm, assumes that the reduction of front-end volume is advantageous. We know of no proof that reduction of front-end volume is effective in improving draft action. The beneficial effects of the forward-sloping diaphragm are apparent; there will be still further improvement if the obstruction to flow represented by the sharp corner connection between diaphragm and table plate is rounded off.

Modified Devices

The Cyclone Front End—The Cyclone style front end, which has been previously considered in some detail in the reports of this committee, is a widely-used substitute for the Master Mechanics' front end. A design is now offered by the builders of this device so arranged that the top plate of the structure is eliminated, and the chamber in which the whirling gas motion is set up extends clear to the top of the smokebox. This eliminates the difficulty of fitting the top plate around the bottom of the stack. This new form is represented in Fig. 2.

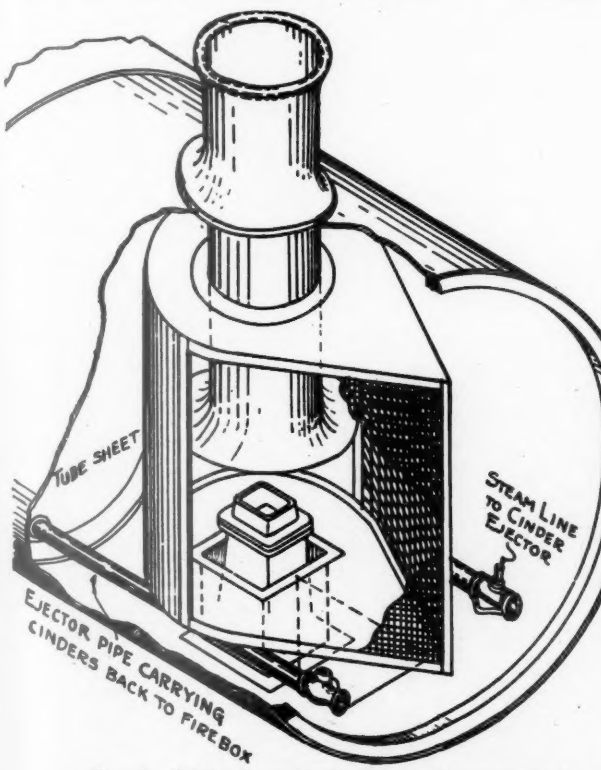


Fig. 3—Coffin Super-Draft front-end arrangement

The Coffin Superdraft Arrangement—This device which has been on the market for several years, but which has not been previously noted in the reports of this committee, consists of a special separator in the front end, and a means of ejecting cinders collected in the front end and returning them to the fire. It is represented in Fig. 3. The usual plates and baffles in the front end are replaced by the separator, which consists of a half-cylinder of solid plate turned backward toward the tube sheet, its axis being the same as that of the stack, and a wedge-shaped extension forward of the stack made of perforated plate. The separator structure extends from a point just below the nozzle to some distance above the stack flare. A small portion of the cinders traversing the tubes passes out through the perforated plate in the wedge, but most of the cinders drop to the bottom where they are picked up by the ejector arrangement. The ejector pipe passes through the throat sheets and returns the cinders to the fire through a specially formed opening in the arch brick. Either feature of this device seems well worth consideration. Installations have been relatively few and operating reports somewhat contradictory.

In conclusion the committee wishes to express its obligation to Professor E. G. Young who, before our meeting on May 17, organized material for our consideration, and afterwards prepared this report.

The report was read by Chairman E. C. Schmidt, Professor of Mechanical Engineering, University of Illinois; J. Traylor and E. G. Young.

Discussion

It was the consensus of opinion that front ends requiring netting should not and would not be used on future locomotives. A few of the reasons given were that the Master Mechanics' front end did not properly control hot cinders going out of the stack and that, with the large firebox of modern power, the fire burns out in the middle leaving incomplete combustion along the sides. The Thompson front end was briefly described. Results obtained so far indicate more even combustion in the firebox, better control of hot cinders, lower back pressure and lower maintenance costs.

The question of slag formation on tube sheets was discussed at length. Many reasons were given as to the cause of this trouble, including poor coal, high firebox temperature, excessive draft and leaks around the flues.

Improved and New Locomotive Economy Devices

Developments in feedwater heaters, circulation devices, superheaters and valves

In the past few years due to the business depression your committee has had very little to report to the association in the way of new devices promoting fuel economy. This year we have a few new devices which we can call to the attention of the members, as well as a number of improvements in existing devices.

Before proceeding with the descriptions of new heaters or improvements, we might indicate the extent to which feed water heaters have been applied to locomotives by bringing up to date a table given in the 1931 report of this committee. See Table I.

The manufacturers of feed water heating equipment have shown considerable activity. The Consolidated Ashcroft Hancock Company has brought out a new heater called the Hancock turbo-injector which is briefly described below.

Hancock Turbo-Injector—This heater is of the open type in as much as the feed water and exhaust steam

are actually mixed. The heater consists essentially of a four stage, turbine-driven-centrifugal pump, and a condensing chamber together with a control valve, an automatic heating valve, and an operating valve. Water from the tank is taken into the first stage of the pump which serves as the cold water pump of the usual open heater and raises the pressure to about 70 lb. per sq. in. This stage discharges into the condensing chamber which is composed of a number of nozzles and combining tubes. Exhaust steam is taken from the exhaust cavity of the cylinders and passes through the control valve to the condensing chamber. Here the cold water is discharged through the nozzle into the combining tubes entraining, exhaust steam thus heating the water. The hot water is taken from the condensing chamber by the second stage of the pump. The 2nd, 3rd, and 4th stages of this pump are the feed-pump portion in which the pressure is raised sufficiently to overcome the boiler pressure and pass into the boiler.

Status of Feedwater Heaters on Locomotives

Year	Pump type	Injector type
1920	7	....
1921	54	....
1922	234	....
1923	1429	....
1924	2123	24
1925	2551	37
1926	3527	362
1927	4918	519
1928	5586	593
1929	6729	838
1931	8755	900
1937*	9728	1170

* Applied or on order as of July 1st, 1937.

The pump is controlled by the operating valve which is ordinarily in the cab. This consists of a pump throttle for starting and stopping the pump and a water regulating valve which regulates the flow. An automatic heating valve is provided to prevent entry of cold water into the boiler during periods when no exhaust steam is available as when drifting or standing. This automatically supplies live steam to the control valve during such periods. To maintain proper balance of conditions a by-pass valve is provided in the suction line to the second stage of the pump which allows excess of hot water to flow into the tank. This hot water is discharged into the tank close to the suction of the first stage and hence does not unduly raise the temperature of the water in the main cistern.

This heater is claimed to heat the feed water to within 15 deg. of saturated steam temperature corresponding to the back pressure. When no exhaust steam is available, the water entering the boiler is heated to about 200 deg. F. by means of live steam as previously described. The weight of the component parts of the heater is 1300 lb., of which about 800 lb. is in the pumping unit.

Elesco Coil Type Heater—The Superheater Company several years ago brought out a modification of their closed-type heater in which coils of 1 in. copper tubing are used instead of straight tubes. Each coil is capable of heating about 2000 gallons of water per hr. and a sufficient number of coils are provided to suit the requirements of the boiler in question. The coils are mounted in a suitable receiver and are connected independently in parallel circuits. As usual the water passes through the tubes which are surrounded by the exhaust steam. It is claimed that this type of heater has higher heat transfer efficiency and because of higher water velocity and more turbulent flow shows less tendency to scale accumulation. The construction is simplified, the weight is reduced and the installation cost is somewhat less than their conventional closed type of heater.

Exhaust Steam Injector—The Superheater Company announces improvement in the exhaust steam injector by the incorporation of an exhaust pressure regulator which adjusts the exhaust steam to exactly the amount which the injector can handle irrespective of exhaust pressure, water temperature in the tank or quantity of water being fed to the boiler. This, it is said, very materially increases the efficiency and stability of the exhaust steam injector and permits it to handle feed water as hot as 150 deg. F.

Coffin Heater—The J. S. Coffin Jr. Company report improvement in their feed water heating system by the development of a new auxiliary heater placed in the forward corner of the water tank. Here the condensate from the closed portion of the heater is reclaimed and mixed with the cold water going to the pump suction. The auxiliary heater is equipped with a suction strainer and also a filter. Separation of oil from the feed water and some de-aeration is accomplished in the auxiliary heater.

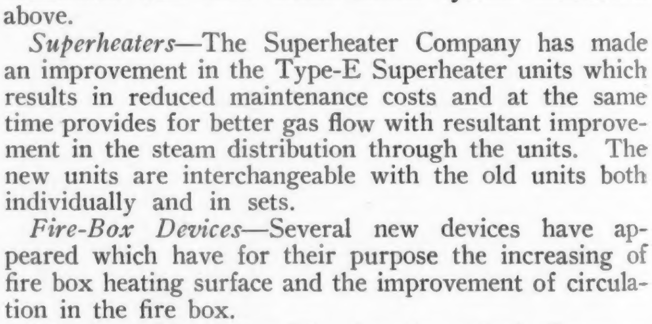
Coffin Tank Type Heater—We do not believe that the Coffin open-type heater has ever been mentioned in these proceedings. This heater is of the open, storage type, being located in the left forward corner of the tender. In common with other heaters of this type it is necessary to control the temperature to which the water is heated to avoid difficulties with water flashing into steam when heated too hot. This heater employs the Standard Coffin pump and control system used in connection with their closed heater system mentioned above.

Superheaters—The Superheater Company has made an improvement in the Type-E Superheater units which results in reduced maintenance costs and at the same time provides for better gas flow with resultant improvement in the steam distribution through the units. The new units are interchangeable with the old units both individually and in sets.

Fire-Box Devices—Several new devices have appeared which have for their purpose the increasing of fire box heating surface and the improvement of circulation in the fire box.

Fire-Box Circulator—The American Arch Company

* * *



Lackawanna Limited, Westbound, New Milford, Pa.

has devised a fire box circulator which provides a tube connection between the side sheets and the crown sheet. This is in the shape of an inverted *Y* with the stem of the *Y* connected to the crown sheet at or about the center line of the boiler, with the legs connected to the side sheet. These circulators serve as a support for the arch.

Downflow Syphon—This is a modification of the well-known Nicholson syphon and differs in that the usual connection to the throat sheet has been eliminated and instead a leg is extended through a sleeve inserted in the bottom combustion chamber and shell sheets. The upper portion of the syphon has also been arranged so that it is fastened to both the crown sheet and door sheet of the fire box. To date we have heard of no applications of this device to locomotives.

Nicholson—Duplex Syphon—The Locomotive Firebox Company has brought out a modification of the Nicholson Thermic syphon which is called the Duplex syphon. In this arrangement the syphon is equipped with two necks, one of which is connected to the throat sheet as before, and the other to either the side sheet or bottom combustion chamber sheet. Thus in installation with three syphons in the fire box the center syphon has one neck connected to the throat sheet and the second to the bottom of the combustion chamber. The two side syphons have one neck connected to the throat sheet and the other to the side sheet of the fire box.

Locomotive Valves—With higher speeds of both freight and passenger trains we may have to revise some of our ideas on the valve setting of the locomotives. This applies not only to new engines with higher boiler pressures, but also on existing engines originally designed for lower maximum speeds. We have no constructive suggestions to offer at this time but merely mention it as a point to be considered.

In this connection, the Franklin Railway Supply Company is reviving interest in poppet valves for steam locomotives. The design is still in the development stage, no applications having been made to our knowledge. Those of us who were at the recent A.A.R. meeting had an opportunity to inspect a model of this new development.

In concluding this report we might call attention to the need for fuel economy devices which are not on the locomotive itself.

It is quite obvious in passenger service that the fuel burned on the locomotive is not all chargeable to the locomotive itself. With increased electrical load due to better lighting and air conditioning, and with increased steam demands on some railroads due to steam system of air conditioning, we find the fuel used by the train itself steadily increasing. While it might seem rather far fetched to call an improved axle generator drive, or more efficient car, or pipe insulation locomotive fuel economy devices, they never the less do fall into this category.

While we cannot direct the attention of the association to any specific devices of this kind we can say that insulation of cars is receiving considerable attention, undoubtedly due to the wide spread application of air conditioning. This includes better sealing of windows and doors to stop leakage from these sources and better sound deadening which ordinarily carries with it better heat insulation. Axle drives have received considerable attention in the past few years with the introduction of more positive types of drives eliminating to a large extent the power lost in slipping belts on the older types.

Insulation of the steam lines, particularly the insulation of the metallic connectors between cars, is still a problem. While certain portions of these connectors can be readily insulated, other portions particularly the ball joints themselves and the coupler heads, cannot very well be covered. It is, furthermore, rather difficult to maintain the insulation on these joints because of their location, being very much exposed to flying stones and the like. The new tight-lock coupler aggravates this condition somewhat in as much as it increases the length of the flexible connections very materially.

The report was read by Chairman A. G. Hoppe, assistant mechanical engineer, C. M., St. P. & P.

Discussion

The discussion following Mr. Hoppe's paper developed the fact that the performance of a locomotive device is always expressed in terms of gross economy instead of net economy. To determine net economy consideration should be given to maintenance costs and constant performance.

The question of how to determine accurately the amount of fuel required to cool and heat a passenger train was discussed at length. A representative of the Engineering Research Division of the A.A.R. briefly referred to a report covering the performance of all types of air-conditioning equipment which contains much data on the consumption and cost of the fuel required for cooling one or more cars. The same basic data can be used to determine the fuel cost for heating a train. A copy of the report will be sent to anyone writing to L. W. Wallace, director, Engineering Research Division, A.A.R., Chicago.

A suggestion was made that a study should be made of the AB freight brake as a means of obtaining further fuel economy. Because of increased train speeds, the air-brake equipment must be properly maintained and operated or else fuel costs rise.

Locomotive Firing Practice—Oil

With the general increase in railway business it has again become necessary to take into the service many new men. It has been so long since we have had to train new men in engine service that the organization for such training may have been forgotten. All will agree that the new fireman is entitled to thorough instruction, counsel and support from not only his fellow enginemen, but from supervisors who are detailed to handle such work.

With an oil-burning locomotive, where there is no material quantity of fuel in the firebox and where, if the locomotive is efficiently drafted, there is only a reasonable amount of excess steaming capacity, it is of the first importance that the fireman so handle his part of the work that when leaving the initial terminal full pressure will be maintained without smoking the locomotive. The adding of a large volume of cold water to the boiler with the injector just before leaving initial terminal is ruinous to this condition. A large volume of water added in this manner will stay near the bottom of the boiler until rapid circulation is started by applying a load to the boiler. The mixing of the cool water from the bottom of boiler with the hot water at the surface naturally reduces the rate of steam generation. The brickwork and firebox are still comparatively cold. Under these conditions it is difficult for the fireman to maintain a full head of steam while pulling out of the yard. Again, if the start is made with the boiler full of water it is

almost sure that sufficient water will pass over through superheater units and cylinders to remove at least the majority of lubrication from the valves and cylinders.

After leaving the initial station and it is possible to sand the engine without objection from adjacent property owners, the flues should be thoroughly sanded. Thereafter best results are obtained by adding three to five scoops of sand quite frequently rather than adding a large amount of sand at less frequent intervals. The amount of sanding is naturally dependent upon the general steaming condition of the locomotive.

A good fireman will split notches on the firing valve quadrant so as to maintain the maximum pressure without popping. Large adjustments on the firing valve produce extreme variations in pressure. These large variations also make it necessary to force the fire to regain pressure previously lost.

Nearly all oil-burning railroads today are using heavy cracked fuel, either straight or blended, but even so, it is not possible to give definite detailed recommendations as to the heating of fuel oil because of the wide variation in character of fuel.

The Responsibility of Enginehouse Forces

It should be the responsibility of enginehouse forces so to prepare the locomotive that when the fireman reports for duty the fuel oil is at a reasonable firing temperature. From that time on the entire responsibility rests with the fireman. If best economy is to be obtained, the fuel should be maintained at a temperature within a range as specified by supervisors or higher authority. There is a temperature for each fuel oil that will give the most efficient results in service. That temperature should be maintained as closely as possible. Fuel-oil thermometers are as valuable as any pressure gage in assisting fireman to burn fuel efficiently.

When the fuel line appears to be obstructed and the blow-back is used to clear the line, it is recommended that the first blowing be through the burner to firebox with tank valve closed. Then close the burner and blow to the tank. The purpose of this is to free the blow-back line of all water before blowing in to the fuel tank. A shot of water in hot cracked or blended fuel may cause the fuel tank to boil over. When relighting the fire always have burning waste or a lighter torch in the firebox before turning on the fuel. Without a flame in the firebox there is serious danger of a backfire when opening the firing valve, due to the hot brickwork gasifying the fuel until there is an explosive mixture.

After a long run and the firebrick and firebox are very hot, either a fair fire should be maintained for a few minutes, even though the safety valves open, or the fireman should close the dampers to prevent cold air from chilling the firebox.

Firemen should note the condition of brickwork at some intermediate stop. If the temperature is uniform throughout the firebox, the brickwork will have the same general appearance throughout the box. Air leaks in fire pans can always be detected by the breaking down of brickwork where exposed to air leaks. Burners out of line can easily be observed by action of the fire. A shortage of air on one side or excess fuel on that side can frequently be observed by noting the stack condition, that is, colored on one side and clear on the other. A grey appearance of firebox sheets indicates uniform temperature conditions. A variation in color, such as black soot in certain spots, lower temperature of firebrick on one side or the other, or carbon accumulations, all point to unequal fire or temperature distribution. These observations should be reported at the end of trip, thereby assisting the enginehouse forces in their effort to maintain your locomotive in good condition. Any erratic details in water-pump operation, injector, firing valve or other appurtenances should be reported. Team work of this character will make work easier for everybody as well as pay big dividends in the saving of fuel.

The report was presented by Chairman R. S. Twogood, S. P.

Discussion

The discussion following the presentation of this committee report was quite extensive and profitable to the large number of persons interested in oil firing practice. Much of it pertained to the methods of heating the oil now generally being burned, which is so heavy as to constitute a real problem in handling both in wayside storage tanks and on the locomotive tender. It was generally agreed that both direct and indirect heaters are required, the latter being necessary primarily for stirring up the oil but used for short periods, only, so as to avoid introducing any more water into the oil than absolutely necessary.

In general, to secure efficient combustion on oil-fired locomotives it was said that air should be mixed with the oil and raised to the firing temperature as early as possible in its passage through the atomizer. Oil should be carried in the tender at from 100 to 200 deg. F., dependent upon conditions, and the statement was made that the use of a thermometer to enable a fireman to maintain this temperature accurately at a predetermined point is a good investment.

Locomotive Firing Practice—Coal

It is the thought of the sub-committee on coal-firing practice to confine their brief remarks strictly to firing practices between terminals, leaving questions for open discussion, due to many systems of firing now in use.

Firemen should arrive at the locomotive on the ready track in ample time to check the firing tool equipment, prepare his fire to suit the requirements of the run to be covered and type of locomotive used, using blower lightly and supplying coal in same proportion to minimize emission of smoke and control boiler pressure so that safety valves will not open.

No hard and fast rule can be made covering depth of fire at start. Good judgment must be used as the conditions under which the start is made, such as grade, weight of train and speed, will influence, to some extent, the kind of fire.

After getting away from terminal the fire should be carried level, bright and light as consistent with the work to be done.

In starting from stations at low speeds, blower can be used to good advantage in maintaining maximum steam pressure and a good fire condition. Fireman should closely observe the water level in boiler and handle his fire accordingly.

Approaching pre-determined shut-offs, fireman should stop firing far enough in advance to minimize smoke emission and control steam pressure so there will be no undue waste of steam at safety valves.

The hook, rake or slicebar should only be used when necessary. They are mostly used to correct mistakes.

Shake grate lightly and as often as necessary to maintain fire in good condition.

Fireman should deliver engine at receiving or pit track with fire in condition to clean without undue waste of fire and coke. He should not allow fire to burn so low that engine watchman would have to build up before cleaning.

There are many systems of firing; single scoop, cross firing, banking and others. All that it is necessary to say concerning these different systems is that any system is good where maximum steam pressures are maintained, minimum amount of smoke; hook, rake or slicebar not used, safety valve not opened, and fire in good condition on arrival at terminal.

Stoker Firing

The stoker is a mechanical device and, therefore, the fireman must furnish the intelligence for its operation. The stoker is designed to fire the coal efficiently and economically if properly manipulated.

To become efficient and successful in stoker operation it is essential that all parts be fully understood by both engineer and fireman. The same general principles that pertain to hand firing pertain to stoker firing.

Ordinarily the stoker will distribute the coal evenly over the entire grate surface. Firemen should not be content to sit on the seat as long as steam pressure holds up. He should make regular inspection of the fire to observe the coal distribution, particularly upon leaving terminal stations, by stopping stoker for a few seconds, even at the expense of losing a few pounds of steam. A fire poorly prepared and not watched the first few miles has been responsible for more fuel waste and low steam than any other one item on stoker fired engines, and charged many times to the stoker. The fire can be built up and maintained on sidings and meeting points with the stoker, if intelligently used.

The report was presented by Chairman W. C. Shove, N. Y., N. H. & H.

Discussion

Considerable attention was given in the discussion of this report to methods of maintaining a uniformly thin fire on the grates, which cannot be sloped over six to eight degrees without danger of the coal working forward to the front of the firebox, especially under present high operating speeds, with locomotives sometimes not accurately counterbalanced. One member said that there is no good operating reason for sloping grades and that it is far better to install level grades unless structural or design reasons necessitate using the sloping type.

The question of adequately instructing reemployed firemen, particularly those without experience, was discussed in some detail. Both fuel supervisors and traveling engineers have a large responsibility in this particular which should begin with selecting the most promising material available.

The Function of AB Freight Brake Equipment

A description of the function of this brake not incorporated in its predecessors

Because the members of this association, generally, are more interested in the operation of locomotive and train brakes than they are in the design and in the method of maintenance, this paper is chiefly confined to the handling and to the operation of modern freight train brakes as a whole.

The distinctive features possessed by the AB freight car brake equipment which were not included in former types of air brakes are:

Initial quick service action, which positively closes all feed grooves and initiates service brake action; or, in other words, insures the application of each brake in the train in service brake operation.

Positive and adequate fixed volume secondary quick service applications, which insures a desired uniform brake cylinder pressure on all cars.

Brake pipe surge dissipated.

Stability of brake cylinder values obtained.

Modified degree of quick service on descending grades, giving increased flexibility of control.

Effective stabilization of service application and avoidance of brakes "creeping on," due to light fluctuation of brake pipe pressure.

Accelerated service propagation—propagation speed is substantially uniform with all degrees of tolerable brake pipe leakage, and is more than twice as fast as that of the former standard.

Accelerated release initiative.

Positive release.

Controlled release of brake cylinder pressure at a single fixed and slower rate.

Uniform recharge—accomplished by automatically restricted charge passage under charging pressure.

Emergency brake action more rapidly propagated, with more effective emergency brake cylinder pressure available, under any condition of previous brake application or release.

High brake cylinder pressure in emergency action.

Accelerated emergency brake application propagation rate—about 40 per cent faster than that of the previous standard, or K equipment.

Controlled brake cylinder pressure build-up in emergency action to fit operating requirement.

Positive and accelerated release after emergency brake application.

Protection against train damage if the train brake release is attempted immediately after an emergency brake application has been made, and the train is still in motion, which is accomplished by automatically holding the brake pipe vent valve of the AB operating valve open for a definite time period, thus preventing the brake release.

Quick action chamber adequately guarded against overcharge.

Briefly stated, these modern features provide in actual service operation of freight train brakes:

A service brake application, in which all brakes will apply and during which approximately 10 lb. brake cylinder pressure will be built up in the brake cylinder of each car, whenever a sufficient service brake pipe reduction is made.

During a service brake application, a surge of air

in the brake pipe will not occur and cause some of the brakes to release.

Advantages of greatly improved brake operation, particularly when retaining valves are being operated, when descending heavy grades.

The rate of propagation of service application—in which approximately 10 lb. brake cylinder pressure is built up—is approximately that of the former type brake application propagation in emergency action, very much shortening the time elapsing between the application of brakes on the head end of train and that on the rear end, greatly reducing the probability of undesired slack action.

Positive release of brakes, which is insured by the release insuring feature through the simple method of automatically reducing the auxiliary reservoir pressure sufficiently below that in the brake pipe to force the equalizing piston to release position.

In conclusion, we may add that the above described improvements in brake operation are of such highly efficient qualities and are so apparent to the engineer that practically nothing new in the present instructions to enginemen for the operation of trainbrakes is necessary, particularly so, as all improvements are automatic in action and are readily apparent to the engineer when operating the brakes.

All enginemen in freight-train service should understand, however, that due to the protective feature against train damage after an emergency train brake application has been made, which feature positively prevents the train-brake release from taking place before a specifically allotted period of time has elapsed—if the train brake release is attempted before waiting at least 70 seconds, preferably a little longer, or until sufficient time has elapsed for all vent valves to close, any attempt to release the train brakes results only in a waste of main reservoir pressure.

The report was read by Chairman W. H. Davies, Wabash.

Discussion

Mr. Davies' report was favorably commented on as presenting a lot of information about the AB brake in a comparatively small space. The thought was expressed that owing to the improved functioning of the AB brake it is possible to operate freight trains over the road in substantially less time and that, therefore, this brake must be credited as an important fuel conservation factor. The smooth operation also practically eliminates broken knuckles and draw bars in trains equipped with AB brakes and, therefore, avoids the necessity of cutting out cars for this cause as well as the maintenance expense necessary for repairs occasioned thereby.

Mention was made of the increased charging time required with AB brakes due to the necessity of charging an extra reservoir. This increase in time runs from 3½ minutes to 7 or 8 minutes in some instances. In justification of this increased time, one of the members said that mechanically, as well as financially, it is foolish to expect a large return without some investment. In other words, if some additional time is required for charging the AB brake this is a small price to pay for the important advantages and essential benefits obtained.

The Utilization of Steam Locomotives

Fuel and water supply for long runs— Care needed to avoid surplus power

Everyone is interested in obtaining the greatest possible service from locomotives and it is believed that the items that are of the greatest assistance in intensive utilization are, first, plenty of coal and plenty of water. You may note the high mileage by oil burning locomotives on different roads and of course, in general, they carry about twice the amount of fuel that a coal burning engine carries. Schedules are fast and hard now days and it is proper to consider that you, in a freight engine, obtain about 10 miles per ton; in a passenger engine about 20 miles per ton of coal, with 100 gallons of water per mile in passenger service and perhaps about twice that in freight service so that if you are going to make two divisions, that is say 250 miles, it means in freight service 25 tons of coal and in passenger service if you are going to run say 700 miles it means 35 tons of coal. These are average figures and, considering the reserves that are necessary to protect against excessive delays, weather and especially heavy trains, it seems to enable us to make long runs and that we are going to need about 45 tons of coal, with either water pans that will continually replenish the water or else tenders with possibly trailing tank cars of water to provide a commensurate amount of water.

Discussing through runs it may be of assistance to mention some situations that have developed and the way they have been overcome. Cooperation of the different departments, of course, is essential. That is, if the yardmaster doesn't readily assume his responsibility in getting the engine to and away from the engine house promptly or to and away from the coal dock and ash pit promptly, the motive power department can do little in running engines through because the yard delays will prevent using the engine.

We frequently find two or three different classes of locomotives at a terminal and there is always a thought that one class should be used instead of the other and although one class may be more economical the time that the engines lay at the engine houses due to changing types frequently burns as much coal as perhaps the larger engine would burn even with a light train.

There is always the case of a train of taking off the head end and putting it over in the yard at which time it means faster movements if another engine can be used and if operating conditions require this change perhaps a relay system will keep the engines going to one of the larger points where you expect to hold them for all necessary work.

In some yards there is no air and it has been difficult to run the engines through, because they required the engines to pump up the brakes for test and it could not be spared to go to the coal dock for coal, fire cleaning and inspection.

In one territory, during a short period, there was an excess of power and to avoid light movements this power was taken out of storage and run to the end of the road where it gradually built up and of course an attempt was made to again store it. However, about that time so much of the power had reached the far end of the road that it became necessary to run it back and it

was returned, several engines at a time, so that it broke up the storage. When engines are in service like this it takes some time to get them out and store them, the net result being that substantially more engines were maintained in service than were required, so that if possible permanent storage should be arranged. That is, determine how many excess engines there are and keep them in storage just as long as possible.

One of the best means of determining the surplus of power is a detail study of the time each class of engine lays at the engine house and a determination as to whether it is possible to turn the engines quicker, doing the necessary work, at which time it may be found that, owing to the odd times the trains move, it is impossible to turn them quicker. Then it may be found that these engines can be used for a short time on puller movements or some local jobs that will return them to the engine house in time for the more important work, thus perhaps replacing a smaller class of power which, although burning less coal, means extra engines in service and, inasmuch as it is a less efficient power, may be nearly as expensive to maintain as the larger engines.

This might all be summarized in one of three sentences!

1—Engines must be maintained in first class condition.

2—They must carry coal and water or else obtain it enroute, enough for the full run.

3—The cooperation of all departments is required, if there is to be any measure of success.

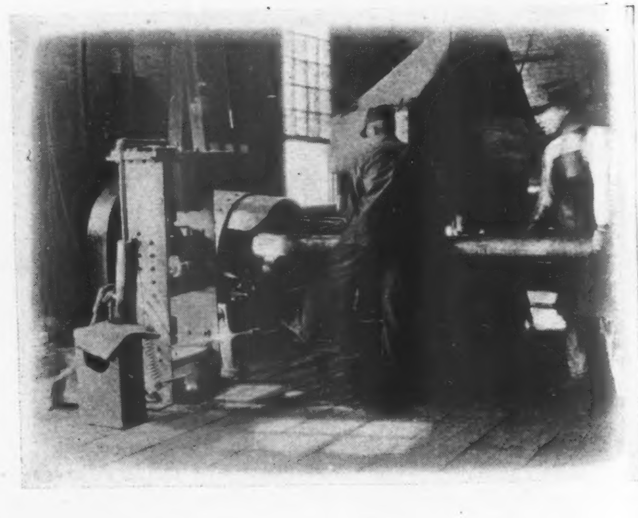
The report was read by Chairman A. A. Raymond, N. Y. C.

Discussion

A lively discussion of this report centered on extended washout periods. On one road, passenger locomotives average 15,000 miles a month and freight locomotives 9,000 to 11,000 miles a month with one washout. These locomotives are equipped with two blow-off valves and a sludge remover. Because of extremely bad water conditions, the enginemen are required on the average to blow down locomotives every ten miles for a period of six to eight seconds. Pyrometers are used on most of these locomotives and the attempt is made to keep the temperature of the superheat around 650 deg. F.

On one road, a special study has been made to determine how to obtain maximum service from motive power. A maximum and a minimum number of miles per day has been set for each locomotive class and if locomotives in a pool are not making their minimum mileage the required number are stored to bring the miles up to the maximum miles required. If, however, the locomotives are exceeding the maximum miles more power is added to the pool.

* * *



Full Program and Keen Interest Features

Boiler Makers' Meeting

Special consideration is given to apprentice training, welding, effects of bad water and general boiler maintenance problems

THE twenty-fourth annual meeting of the Master Boiler Makers' Association, held at the Hotel Sherman, Chicago, September 29 and 30, was notable for the active discussion of six important topics specifically related to boiler shop operations, with particular emphasis on apprentice training, welding, corrosive effects of bad water, and general boiler maintenance problems.* A total of 150 railroad members and guests registered for the meeting; the discussions were exceptionally interesting and to the point; constructive consideration was given to mutual problems by this aggressive body of railway supervisors who evinced thorough acquaintance with all phases of their work, judging by the amount of detail included both in committee reports and the subsequent discussions.

In opening the meeting, President M. V. Milton, chief boiler inspector, Canadian National, said that no radical change in conventional steam locomotives had yet proved its desirability in practice and that mechanical engineers are confronted with a difficult task in securing further increases in capacity with economy of operation, owing to weight and size limitations. One solution, however, is the use of high-tensile steels which permits going to higher boiler pressures, a subject of great interest to boiler makers as they are called on to aid in the design and at all times maintain locomotive boilers in condition for safe, economical operation. President Milton said that the Master Boiler Makers' Association affords the greatest educational opportunity to boiler foremen in solving mutual problems because it brings together boiler makers from railroad and contract shops throughout the country.

Following President Milton's address E. R. Battley, general superintendent of motive power and car equipment, Canadian National, also congratulated the association on effective work in the past and said that it is largely responsible for improvements in boiler material specifications, design and maintenance, which have been made to date. Mr. Battley made a strong appeal for the training and development of competent railway boiler forces and said that boiler foremen must not think that they have done their full duty until they have developed young men qualified to fill their positions when the need arises. He said that this training takes time, patience and money, all of which, however, are well worth while.

Other speakers who addressed the association included D. C. Buell, director, Railway Educational Bureau, Omaha, Neb.; Colonel C. C. Stibbard, chief operating officer, Board of Railway Commissioners, Ottawa, Ont.; and J. M. Hall, chief of the Bureau of Locomotive Inspection, Interstate Commerce Commission, Washington, D. C. Secretary A. F. Stiglmeier, general boiler department foreman, New York Central, described in his report the efforts of the officers to perpetuate the work of the association during depression years and paid tribute to the many who have helped in this work. He reported that the membership of the association is now 152, an increase of 87 from 1935.

Election of Officers

During the last business session the following officers were elected to direct the association's activities during the coming year: President, W. N. Moore, general boiler foreman, Pere Marquette, Grand Rapids, Mich.; vice-president and chairman of the executive board, Carl Haper, general boiler inspector, Cleveland, Cincinnati, Chicago & St. Louis, Indianapolis, Ind.; secretary-treasurer, A. F. Stiglmeier, general foreman boiler department, New York Central, West Albany, N. Y. M. C. France, general boiler inspector, C. St. P. M. & O., St. Paul, Minn.; L. W. Steeves, boiler foreman, C. & E. I., Danville, Ill., and C. W. Buffington, master boiler maker, C. & O., Huntington, W. Va., were elected to three-year terms on the executive board and L. R. Haase, district boiler inspector, B. & O., Swissvale, Pa., was elected to serve out the unexpired term on the executive board of W. N. Moore, who was elected president of the association.

Mr. Hall's Remarks

President Milton extended the courtesy of the floor to J. M. Hall, chief of the Bureau of Locomotive Inspection, I.C.C. who spoke extemporaneously. Mr. Hall told the members that the bureau had approached the consideration of welding on locomotive boilers with a great deal of conservatism and that, as the art of welding had progressed had gradually lifted restrictions as to welding to keep pace with progress. He remarked that welding is an art but that not all welders are artists and strongly emphasized that every care should be employed to assure the highest quality of work. He told of the background of the design and construction of the recently-built, all-welded, experimental locomotive boiler on the Delaware & Hudson and cited this as evidence of the bureau's willingness to take a broad view on the subject of welding. Mr. Hall expressed satisfaction at the cordial relations existing between the railroads and the bureau. "As Walt Wyre says, 'Don't swallow your cud of tobacco when the federal inspector is coming, because really he's your friend'," said Mr. Hull in closing.

* A paper, "Pitting and Corrosion in Locomotive Boilers," by J. L. Callahan, presented at this meeting, will be published in a later issue.

Colonel Stibbard's Address

Colonel Stibbard told of the work of the inspectors of the operating department of the Board of Railway Commissioners particularly in relation to inspections of locomotives as a means of preventing fire losses in the forested areas of the several provinces of the Dominion of Canada and cited statistics to indicate the value of this work. For example, he said: "In 1919 the total mileage under the board's jurisdiction was 32,720 of which 11,622 were through forested territory. During that year, 1919, there were 1,262 fires in forested territory, resulting in 237,880 acres being burned, with a value of $534,603.

In 1923 the railway mileage had increased from 32,720 to 38,297, and during that year, 1923, there were 1,013 fires with a burnt area of 640,755 acres having a value of $925,850 (not far short of a million-dollar loss in one year). It will be seen then, to what alarming figures the railway caused fires had reached and it was realized that something had to be done to prevent this enormous wastage of the country's natural resources. Accordingly every effort was made to combat this menace by more rigid inspection of locomotives, more frequent fire patrols, better and more up-to-date fire-fighting equipment. As a result of the tightening up of locomotive inspections by railways, Provincial and Board's inspectors the maintenance of fire-protective appliances on locomotives was concentrated upon and from a high of 436 locomotives having defective fire-protective appliances in 1918 the low figure of 28 defective locomotives was reached in 1935. Consequently the value of property destroyed by fire receded from the high figure of almost a million dollars in 1923 to the low figure of approximately $2,500 in 1936, the latter figure being the lowest since records have been kept." In conclusion, Col. Stibbard said, "Perhaps you may wonder why I have dwelt at such length upon fire prevention matters at a conference of this kind. It is because the master boiler makers are the ones who, in the first instance, can contribute the greatest amount of good in this direction. At this conference you will no doubt have sub-committees dealing with such important questions as improved draft arrangement in front ends, nozzle openings, sizes of netting meshes and many other questions pertaining to the front end of locomotives. In all these the question of fire prevention is ever present and must receive its due consideration, and these few remarks are for the direct purpose of reminding you at this time of your responsibility in assisting in the preservation of the forest reserves of the North American continent."

The Training of Boiler Maker Apprentices

The outstanding need in the boiler shop today is young men capable of developing

By D. C. Buell

Director, Railway Educational Bureau, Omaha, Neb.

A timely article in a recent number of the *Railway Mechanical Engineer* states: "The outstanding need in the successful operation of the boiler department today is not tools, equipment, or machinery; it is men, or rather young men—apprentices who are sufficiently interested to be developed in the fine arts of the trade." The article continues by stating, "The question is asked daily in every shop where construction work is done: Who is going to take the layout job when the present layout man quits, or is pensioned? Who is going to be the next flanger, boiler inspector, assistant boiler foreman, and general boiler foreman?" There are many wishers who would be glad to take any of these jobs; but where is the young man who will apply himself studiously, long enough to qualify, even to start on any of the jobs listed?

Analyzing this thought further, what is being done to correct this undesirable condition?

The actual ratio of apprentices to mechanics in the railroad field is 1 to 20. If every one of the apprentices indentured completed his apprenticeship, there would be only enough mechanics made to take care of slightly more than a one per cent turnover. Considering the apprentices who do not complete their apprenticeships for one reason or another a smaller turnover than has just been mentioned is actually provided for. As you know, in handling forces it is the usual procedure to figure on a minimum turnover of at least three per cent.

Let us consider the attention given to apprentices now in service. In the first place have they been selected properly? The proper selection of apprentices is a responsibility which lies with the management. The railroads have had over a hundred years of experience in the selecting and training of employes. Furthermore approximately 45 cents of every railroad dollar is spent on wages. Consequently from a personnel standpoint and from a financial standpoint, this matter should be of utmost importance to the railroad company.

The prospective apprentice is completely inexperienced when he seeks employment and often is only looking for a job, and not necessarily a steady one. On the other hand an applicant may have a strong desire to learn a certain trade. But if there happens to be no vacancy in that craft, it is not unusual for him to be started on an apprenticeship in some other craft, say the boilermakers' craft where there is a vacancy, although he has no desire to learn the boilermakers' trade. He may not be adaptable in any way to learn the trade, and another "misfit" is in the making. He is unhappy in his work and he is costing the company money by "getting by" on the job instead of being interested in his work, and performing it satisfactorily and efficiently. It is his opinion that boiler work is dirty and hard work, with little opportunity for advancement. Not a great deal is expected of him, and he gives less.

No one has told him that if he is acceptable and learns the trade properly (which we will come to a little later), he not only can become a first-class boilermaker but also a first-class welder, a qualified iron and steel worker in a contract shop; that the only difference

between boiler layout work and sheet metal pattern drafting is the consideration given the thickness of the material; that a full-fledged boilermaker should be a qualified inspector; and finally that there are many positions of responsibility with very attractive remuneration in this line of work waiting in vain for qualified, trained men to fill.

For the most part, apprentices are not selected properly on American railroads at the present time. The higher the entrance requirements or standards for apprenticeships, the higher will be the type of young men who strive to secure employment as apprentices. This has been proved on a few railroads during the past ten years.

Training and Advancement

The next question is how are our boilermaker apprentices being trained at the present time, and how should they be trained?

It might not be out of place to mention at this time that probably in no other trade, proportionally speaking, are more helpers advanced to mechanics than in the boilermakers' craft. This is a false solution to the problem. It is no more reasonable to assume that changing the rate and title from helper to mechanic makes a qualified mechanic than it would be to confer the title of Doctor upon a nurse and expect her to perform all the duties of a doctor. Some supervisors follow this procedure, and claim it is satisfactory in emergencies. However, the helper who has been set up to a boilermaker establishes seniority, and becomes a permanent employe classified as a boilermaker, and no steps are taken to prevent a recurrence of similar emergencies. Such a so-called mechanic is nothing more than what is termed on some roads a "specialist," "advanced helper," or "handy man." He is not a qualified boilermaker as specified in the usual agreements between management and the employes.

At the present time boilermaker apprentices are considered in the sense of man-hours on most roads, with little attention given to shop schedules in their practical training and no thought given to technical training. There is a prevailing practice to keep an apprentice on the job which he performs most efficiently, instead of shifting him periodically so that he will receive necessary training in all phases of his trade.

Ratio of Apprentices to Mechanics

The ratio of apprentices to mechanics is of first consideration in working out a proper training program. This ratio should be sufficient to provide at least for the actual turnover on each road.

It has been found that where a modernized apprentice training program is in effect and standard entrance qualifications established, there is no difficulty experienced in securing suitable applicants both physically and mentally for boilermaker apprenticeships.

The apprentice is observed very closely during his probation period to judge his aptitude for learning the boilermakers' trade. If it develops that the apprentice is not showing the proper aptitude for learning this trade, he should be eliminated before the expiration of the probation period specified in the agreement. This should be done in justice to both the young man and the company.

Definite shop schedules should be set up so that each apprentice receives practical training in all branches of the trade. This schedule should be made up to be in accord with the facilities at the shop where it is to be used, and should follow a logical procedure.

In conjunction with his practical shop training, the boilermaker apprentice should also be required to qualify on a definite technical training schedule.

This technical training schedule should include a review of shop mathematics, reading of blueprints, freehand shop sketching, and the fundamental principles of layout problems including parallel-line development, radial line development, and triangulation. This should be followed by practical boiler layout problems. Studies on boiler shop practice should be included in this technical training schedule as well as locomotive inspection, boiler calculations, seams, and patch design.

Competent Apprentice Supervisors

The entire apprentice training program on each railroad should be under the direct jurisdiction of a fully

* * *

qualified supervisor of apprentices whose responsibility it is to see that the apprentices are shifted properly according to the shop schedule and to see that the apprentices adhere strictly to the study schedule. It is also the responsibility of the Supervisor of Apprentices to see that each apprentice is interviewed individually at least once every thirty days for the purpose of giving each apprentice such assistance as he may require and to test him on previous subject matter. The supervisor of apprentices should be furnished with one or more assistants if necessary to enhance this type of work.

The boilermaker apprentices who serve their time under such a system will be outstanding boilermakers, from whom supervisors and men for special jobs may well be selected.

The fact should not be overlooked that it takes four years to develop this class of mechanic; and by starting a proper apprentice training program immediately, it will still be four years before this type of man will be available.

Pitting and Corrosion of Boilers and Tenders

Committee reports present practice in repairing boilers and tenders

A questionnaire was sent to the leading railroads in the United States and Canada, the questions of which were confined to locomotives built during the past 15 or 20 years. While the committee has endeavored to report on conditions existing on all roads, a difference of opinion was found in some cases; therefore, this report presents the practice in effect on a majority of roads for repairing locomotive boilers and tenders made necessary by pitting and corrosion of the various parts involved.

Smokebox

The average life of a smokebox varies from 12 to 20 years after which time renewals are necessary because of pitting and corrosion from chemicals of sulphuric-acid nature, particularly at bottom of sheets, formed from collection of cinders and moisture or condensation from leaks from various appurtenances in front end, also cinder cutting due to high velocity of forced draft. This action from a chemical standpoint can be overcome to a great extent by eliminating leaks in smokeboxes and by the proper cleaning of cinders.

Some roads build new boilers with smokebox sheets ¾ in. thick with a ¾-in. reinforcing liner which extends approximately to the side center line of boiler. This provides a good support for the cylinder-saddle bolting and also prevents cracking of the smokebox sheet above the cylinder saddle.

The majority of roads continue to build boilers with ½-in. sheet in smokeboxes with either a ⅝-in. or ¾-in. liner extending approximately to the side center line of boiler. Most roads make repairs to the smokebox front, door and liner at the bottom of sheet by application of electric-welded patches.

Tube Sheets and Boiler Shell

The average life of the front tube sheet varies from 10 to 16 years. Renewals were due to pitting on the water side, at the bottom and sides of flanges, cracking in knuckles and enlargement of holes. The cracking at knuckles is due to expansion cracks caused in some cases by a small radius on the flue sheet, and, at times, to excessive rolling and working of flues when holes are enlarged.

Various types of repairs are made such as applying patches at the bottom where pitting occurs at the flanges and the ¾-in. sheet when the locomotive is shopped for classified repairs. Some roads apply patches by cutting through bridges of flues, while others use a scalloped weld. Fig. 1 illustrates different type of repairs.

Pitting of boiler shells is mostly confined to the inside of the bottom shell courses and is more pronounced on the first course because of the application of boiler checks for feedwater. The water on entering the boiler contains dissolved oxygen and carbon dioxide gasses, which when liberated in the boiler are more active at this time and, in our opinion, are contributing causes to pitting in shell sheets.

We have noted circumferential grooving, usually not deep enough to reduce the factor of safety of the shell, which was caused by improper storage of the locomotive.

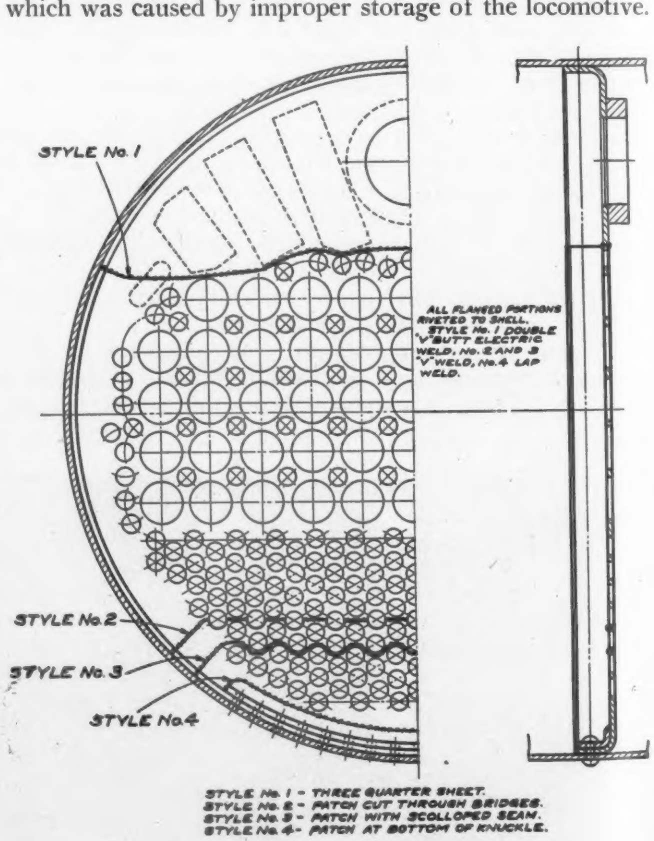


Fig. 1—Repairs to front tube sheet

With the locomotive stored and air-tight, a certain amount of moisture due to atmospheric conditions will form at the top of the sheet on the inside of the boiler. When the air outside is warm this moisture runs down the sides of the boiler causing slight grooves as mentioned. Grooving adjacent to circumferential seams is considered serious if over $\frac{3}{32}$ in. deep as there is a possibility of rupturing the shell at this location due to expansion and contraction. For stored locomotives, it is recommended

that bottom corner washout plugs be removed to permit circulation of air. If the locomotive is stored in a damp place, a pan of unslaked lime should be placed in the firebox and also on top of the flues to absorb the moisture; this will eliminate corrosion of sheets.

Most pitted conditions are repaired by applying patches on the outside of the shell and are more economical than the application of new bottom sections. At times, inside liners are applied for a pitted condition at the bottom of the back-shell course and at the outside throat sheet. This eliminates opening up a circumferential seam at the shell course and the outside throat sheet, which would be necessary if the patch were applied outside. With this arrangement, throat-sheet braces are riveted to the liner and the boiler shell, and set to suit the additional thickness of the liner.

Most of the trouble with pitting or grooving at the back flue sheet, regardless of the type of the boiler, is experienced at the top of the sheet or knuckle. This pitting or grooving usually develops on the water side due to expansion and contraction, and in course of time develops into a cracked sheet.

Repairs are made in some cases, to run out flue mileage, by applying flue-sheet knuckle patches, which patches should be large enough to take in the top row of superheater flues and wide enough to suit the pitted condition. Patches are applied either by cutting through the flue-sheet bridges or scalloped seam.

When the locomotive is shopped for classified repairs, the flue sheet and knuckle patch should be removed, although some roads, if the balance of the sheet is in good condition, apply flues with the original knuckle patch. The life of the flue sheet depends on the type of service, size of boiler and boiler pressure, and varies from 4 to 12 years service.

Crown, Sides and Door Sheets

Some roads report pitting, grooving and cracking at the front end of the crown sheet. Repairs are made by applying electric-welded patches as shown in Fig. 2. The best method in applying these patches is to chip both sides of the patch to a bevel of 45 deg. for a butt double V-weld. After the patch is set in place, the first layer of the weld is applied to the fire side of the sheet; the second layer is applied from the water side and the third from the fire side. Fig. 2 illustrates an electrically welded seam at the crown sheet and back flue sheet; however, the patch may be riveted at this seam in lieu of the welded connection.

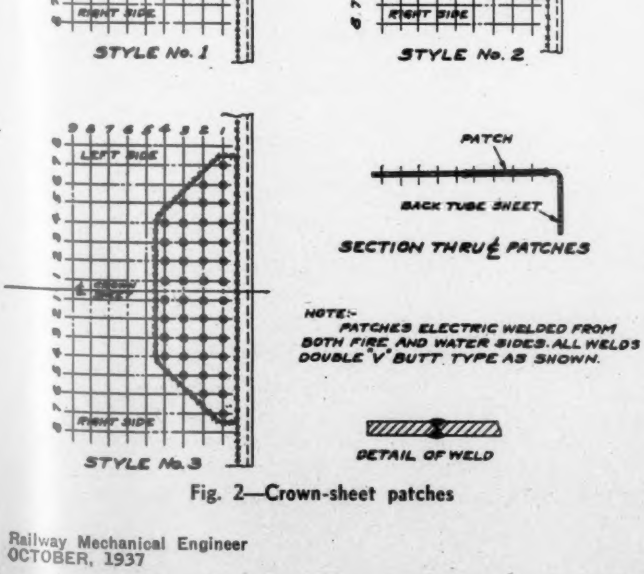


Fig. 2—Crown-sheet patches

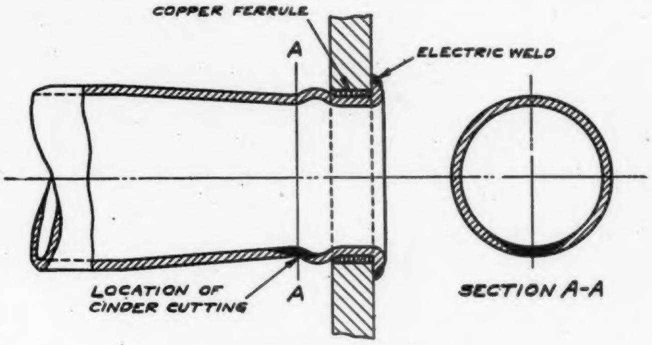


Fig. 3—Cinder-cut flue

Arch Tubes

With modern arch-tube cleaners it is only necessary to turbine tubes at washout periods and their removal is mostly due to brick rubs, although at times they are removed because of blisters or mud burns caused by scale forming on the water side of the tube; however, this latter is purely a matter of improper maintenance. Some roads remove arch tubes at the time of the flue removal although others do not remove tubes if they are in good condition. In our opinion, new arch tubes should be applied when flues are removed.

Flues

The life of flues depends entirely on the type of the locomotive and service required. In certain sections of the country, the full four-years service is obtained with a possibility of an extra year extension, whereas in other sections, with the same type of locomotive, flues are removed in about 2 or 3 years, because of cinder and fire cracking. Fig. 3 shows where this action takes place as caused by high-velocity forced draft and unburned fuel. Cinder-cut flues can be overcome by applying heavier gage safe-ends on new or second-hand flues or new flues purchased with heavier gage at the firebox end, the length of the heavier-gage safe-end is about 12 in.

Tank Cisterns

Pitting and grooving of tank cisterns usually takes place at the bottom and sides along the edges of the angle or tee irons. This is due to water conditions and can be corrected to a great extent by proper water treatment. Bottom and side sheets of coal spaces are subject to corrosion because of sulphuric-acid action from wet coal.

Proper maintenance of splash plates and cross braces will go a long way in prolonging life of the cistern; if bracing is not in good condition at all times serious trouble such as cracking of sheets will soon develop. On new or repaired cisterns it is recommended that a protective coating of paint be applied to water space.

Proper water treatment, whether it be chemical or electro-chemical, has materially increased the life of locomotive boilers and tenders, decreased maintenance cost, eliminated intermediate boiler washes, and in treated-

water districts gives freer steaming boilers due to elimination of scale on firebox sheets and various other reasons.

Discussion

The general report of the committee was read by Chairman L. R. Haase, district boiler inspector, Baltimore & Ohio, with one section presented by J. L. Callahan, service engineer, National Aluminate Corporation and additional extemporaneous discussion by other members of the committee. J. J. Powers, system boiler foreman, Chicago & North Western, said that pitting difficulty on the North Western is now largely overcome due to effective water treatment and the extension of locomotive runs which permits in most cases passing up unsatisfactory boiler water sources. He said that good results have been obtained with the Gunderson electrolytic process, also with certain commercial paints applied to boiler interior surfaces and the use of tannin-treated feed water which is beneficial in retarding the development of caustic embrittlement cracks.

Frank Yochem, chief boiler inspector, Missouri Pacific, raised the question if boiler sheet cracks around staybolt holes, commonly charged to caustic embrittlement, are not in reality due to excessive stresses developed in improper fitting and application of sheets during the manufacture of boilers. This opinion was challenged and also supported to a certain extent by other speakers from the convention floor. Before concluding the discussion a number of well-known railway water engineers and chemists were called on for comments, the general substance of which was that satisfactory railway water conditions cannot be secured without the hearty co-operation of representatives of both the water service and boiler departments.

Preventing Cracks in Back Tube Sheets

Practices which prevent cracks in flange radius and out from flue holes

The committee being familiar with the importance of this subject deemed it best for each member of the committee to submit an individual report covering results on his own and neighboring railroads.

Report by H. A. Bell

This subject includes defects that should be segregated, since the cracks running horizontal are prevalent to a greater extent in poor or bad-water territory, while the cracks running vertical from the flue holes occur in all water districts. The horizontal checks and cracks at the top knuckle of the tube sheet are primarily caused by corrosion—aided by the normal working of the boiler. The vertical cracks and checks from the flue holes are not influenced by corrosion—to as great an extent—and are generally caused from working flues, or location of flue holes too close to the radius of the flange. Both the horizontal and vertical cracks give more trouble on radial stayed, or wagon top boilers, and on high pressure locomotives in hard service.

At different times some or all of the following practices were thought in part responsible for these locomotive conditions: Cold flanging; flanging crossways of the so-called mill grain; not annealing sheets after flanging; too small radius in flange; material too thin; working over flues too hard, and flue holes too close to radius of flange.

A test of hot vs. cold flanged sheets (both properly annealed after flanging) did not show any difference in the life of the sheets in service. But sheets not annealed developed defects quicker than did the sheets that were properly annealed.

Experiments with a larger radius in the flange gave better results, but necessitated moving or leaving out flue holes. Heavier material did not give as good results as did the standard ½-in. sheets.

Treated water and welding reduced the working of flues and helped the vertical cracking, but made no difference in horizontal cracks.

Leaving out or relocating flue holes too close to the flange helped vertical cracks.

Flue sheets having a large (2 in.) radius at the top flange were applied—the rivet row across the top was on a 45 deg. line instead of 90 deg. and the crown sheet was left longer at top front and flanged down over the tube-sheet radius. These applications never developed any horizontal cracks in the top flange of the tube sheet, but did crack the crown sheet horizontally at the firebox calking edge. This was abandoned as it had only transferred the trouble.

Tube sheets copper plated by the oxy-acetylene process (after flanging) was tried without success.

Tube sheets sprayed with zinc by the oxy-acetylene process was tried without success.

Of the items enumerated, the following have been found to be beneficial: Anneal all sheets after flanging. Allow as large a radius in the top flange as possible. Locate flue or tube holes at least 3 in. from the heel of the flange. Reduce working-over of flues as much as possible (expanding and rolling).

The following methods of repair are successful in restoring back tube sheet to the extent explained:

1—Application of a new top portion of sheet by riveting and welding. This repair will generally restore full life to back tube sheet.

2—Crack welded and covered on water side with a riveted or welded cover patch. This repair will generally restore one-quarter life to the back-tube sheet.

3—Crack welded and reinforced by ⅜-in. boiler plate strips 2 in. wide, running from the calking edge of the crown sheet on the water side to near the top of top flue holes, reinforcing strips to be welded all around and located about 6 in. apart, the end strips located just beyond the end of the crack. This repair will generally restore one-quarter life to the back tube sheet. However, this repair should not be attempted except where the conditions are favorable, i. e., where there is only one horizontal crack or check, and the tube sheet is not excessively pitted or corroded.

As a general rule the application of a new ⅛-in. sheet is the preferred repair.

Report by E. E. Owens

This trouble is like pitting and corrosion, it has always been with us and in all probability will continue to be a source of trouble and considerable expense. However, we can devise ways and means of reducing this trouble to a minimum by consultations and expressing

our views at meetings such as the one now being held.

The causes or reasons for defects developing in the back flue sheet are expansion and contraction. As this condition will always be with us, our efforts should be directed to controlling this factor as much as possible. The first consideration should be the selection of perfect boiler plates, uniform in thickness and free from lamination and conform strictly to the requirements of the A.A.R. Specification M-115-36 Grade A firebox steel. While some railroads use steel manufactured by different corporations and which have an alloy content, it has been my experience that there is not much difference in the life or service obtained before the defects develop. Regardless of the kind of steels used, the life of flue sheets depends upon the treatment they receive from the time they are delivered by the steel mills.

There is no noticeable difference between hot or cold flanging if the sheet is properly annealed after flanging.

Proper layout of the flue holes providing a liberal area between holes and flanges is important. At the top where cracks are apt to develop vertically out from flue holes, the limit line between the edge of the flue hole and the heel of the flange should be at least 3 in.

Flue sheets should be flanged to as near a correct and close fit as possible in order to avoid the necessity of heating during the process of fitting up, which heating destroys the annealing qualities.

After the flue sheet is applied we should concentrate our efforts toward insuring proper treatment while in service. In the first place, the flues should be welded to avoid excessive working of them by hot workers. I do not believe any damage is done if flues are given a light expanding with the Prosser expander at monthly inspection periods for the purpose of keeping flues tight in the holes and jarring off scale, provided the boiler is cold.

Care must be taken in engine houses when blowing down boilers, washing and filling them up, to allow for a reasonable length of time for the boiler to cool off, and to see that the temperature of the washout water is not less than 120 deg. F. and the fill up water not less than 180 deg. F.

The boiler should not be crowded nor the pressure raised too quickly when firing up, and after the pressure has reached the proper amount the fire should be watched closely and the pressure maintained as evenly as possible from the time the engine is dispatched until it returns to the cinder pit where the operation of cleaning or knocking the fire should be watched closely. It is my opinion that the abuse a firebox receives when standing around terminals and going over cinder pits contributes largely to all firebox troubles.

As flue sheets are subject to cracking in top knuckles after a given period of service, both vertically and horizontally, the length of service depending upon the class of service, water conditions and amount of abuse a firebox receives through ordinary terminal handling, we should consider methods of repairs which can be made, some of which are more effective than others. It is my opinion that the nature of repairs made should be governed by service requirements. For instance, when we have an engine that has made approximately half of the expected flue mileage, we apply a knuckle patch extending down and taking in one row of superheater flues. This insures against failure during the balance of the expected flue mileage and in most cases permits an engine to run the full limit of four years. Also, when it is desired to keep an engine in service for a few months or until it can be spared and held for repairs, horizontal cracks are cut out and welded from the water side. We have been successful in holding knuckles in this manner from eight to twelve months. The vertical cracks cannot be repaired in this manner successfully. However, this method of repair will permit keeping an engine in service thirty to sixty days. If longer service is desired the flue must be removed, the crack welded and a small patch welded over the knuckle and flue hole from the water side. This method necessitates removal of a part of the front end appliances and is almost as expensive as applying a complete new knuckle, the only saving being in the time engine is held out of service and the cost of one flue as compared with several in an entire new knuckle.

We have tried various methods of prolonging the life of flue sheets, but as yet have not developed any that will prevent them from cracking before the expected flue mileage is obtained. Bronze coating of knuckles with acetylene process prevented pitting but this method de-

* * *

stroyed the ductility of the steel, and horizontal cracks, in some cases, developed earlier in the life of the sheet. We had no more success with a heavy sheet, ½ in. being our standard.

About a year ago we started welding on ½-in. by ¾-in. reinforcing straps over the knuckle on the water side every 8 in. It remains to be seen whether or not we will receive any benefit from this application. However, as I see it, if the knuckle is made strong enough to withstand the bending action, the trouble will be transferred to the end of crown sheet at the flue sheet, the calking edge or through the first row of crown stay holes, and it will then be a question which is the greater evil, a cracked flue-sheet knuckle or crown sheet, and which can can be patched more economically.

Report by G. E. Burkholtz

Cracking in the radius of the back-tube-sheet flange and out from flue holes has been a source of constant trouble to the railroads. The steel used for these sheets is of great importance; steel with low carbon content will give it more ductility and will overcome cracks in the bends. The proper layout of the flue holes, providing a liberal area between the flue holes and the flanges, is also important in preventing such trouble. Flue sheets should be annealed after either hot or cold flanging to relieve stresses. Excessive working of flues can be eliminated by electric welding flue beads on the back sheet, which welding is done primarily to prevent leaking.

Factors which promote cracking of back tube sheets and out from flue holes, by permitting too rapid expansion and contraction, are: Improper drafting, excessive use of the blower, blowing down the boilers too soon after the fires are drawn, the use of cold water in washing boilers, forcing fires too rapidly, and the non-treatment of feedwater.

About four and one-half years ago we made it standard practice to anneal back flue sheets after they were flanged. None of these sheets have cracked in the radius or out from flue holes. Our standard is a ¾-in. radius. We have no set distance from the flange to the flue holes; we make it as much as possible. The method of making repairs on the railroad with which I am associated is to renew the whole sheet if it shows any sign of cracking either in the radius or out of from the flue holes.

Report by L. Nicholas, Chairman

The trouble experienced, and the methods used to make repairs, I find to be the same on the railroad with which I am associated and on neighboring roads, as reported by other members of the committee. The recommendations for preventing such trouble are much the same in each report.

I cannot agree that the welding of flues eliminates cracks in the radius of the flange, as from my experience this trouble started with the welding of beads of superheater flues, which caused sheets to be more rigid and all the stress from expansion and contraction was exerted on the sheet at the knuckle of the flange. So the best we can do to prolong the life of sheets is to keep the surface free of scale, either by using good boiler feedwater, or by a regular period of expanding flues.

We have a few back flue sheets applied which are of an alloy content, one of which has been in service for three years without any indication of checking or cracks, while sheets manufactured of our standard firebox steel have been cracking in radius in less than two years.

Summary

1—Use the best grade of firebox material.
2—Annealing of sheets after flanging.
3—Keep sheets free from mud and scale.
4—Care in use of injector to keep boiler near equal temperature.

Discussion

That the railroads are troubled seriously by cracks in tube sheets was indicated by spirited discussion of this report. The ways and means adopted by many roads to minimize this trouble are well summarized in four recommendations embodied in the conclusion of the report, namely: (1) Use the best grade of firebox material; (2) anneal flue sheets after flanging; (3) keep sheets free from mud and scale and (4) use care in the use of the injector to keep the boiler at uniform temperature. It was also mentioned that direct steaming had had a beneficial effect in preventing cracked sheets. One member ventured the opinion, in conclusion, that flue sheets will continue to crack, in greater or less degree, as long as flues continue to expand and contract.

Proper Thickness of Front Tube Sheets

Committee report on survey of 86 per cent of locomotives in U. S. and Canada

Following the Committee's report in 1936, the railroads in the United States and Canada were again canvassed to ascertain what thicknesses of front flue sheets had been adopted by the various roads; this inquiry embraced 46,267, or 86 per cent, of the 53,984 locomotives owned and operated in the two countries. While last year's report gave the existing practice on the various roads at that time, this year the committee endeavored to ascertain what the same roads would consider the proper thickness for boiler front tube sheets if new locomotives were to be built at the present time. Table I gives the results of the survey.

A total of 56 roads were canvassed and from the replies received the committee has divided the roads into groups A, B, C, D and E. Roads in group A own more than 2,000 locomotives; those in group B own more than 1,000 and less than 2,000 locomotives; those in group C own more than 500 and less than 1,000; those in group D own more than 250 and less than 500; and those in group E own less than 250 locomotives. A summary of the replies received from all the roads is given in Table II.

Compared with last year's report, there is a drop of

Table I — Recommended Thicknesses of Front Tube Sheets for New Locomotives

Thickness of front tube sheet, in....	½	9/16	⅝	¾	⅞
Number of locomotives	6,535	2,745	23,741	13,209	37
Proportion, per cent	14.12	5.94	51.31	28.55	0.08

NOTE: This table is the result of an inquiry made to ascertain what the railroads in the United States and Canada would consider the proper thickness of front tube sheets for new locomotives.

Table II — Summarized Replies on Thicknesses of Front Tube Sheets Adopted by Various Railroads

Line No.	No. of Locos.	Thickness of front tube sheet, in.	Remarks
1	E	3/4	Adopted this thickness 16 yrs. ago. Previously used 1/2 in., the latter gave trouble due to cracked knuckles and bulging.
2	B	1/2, 9/16, 5/8	The boiler pressure and area to be supported governs thickness of sheet. Boilers with 310 lb. per sq. in. pressure have 5/8-in. sheets. On lower pressure boilers 9/16-in. and 1/2-in. sheets are used.
3	C	1/2, 9/16	Experienced some cracked knuckles due to use of small radius flange. Now using 1 1/2 in. radius which increases life but sacrifices some flues.
4	A	3/4	Occasionally experienced circumferential cracks in knuckle at bottom and sides of sheet. Have some sheets 27 yrs. old and still good.
5	E	3/4	For new locomotives the preferable thickness is 3/4 in.
6	C	1/2, 9/16, 5/8, 3/4	Governed by builders' practices based on past successful experience. Shops report no trouble with various thicknesses. Probably favor 9/16-in. sheet.
7	A	5/8	Standard for all modern locomotives.
8	A	5/8	Occasionally have cracking and grooving at heel of flange. General cause for renewal is enlarged and distorted tube holes.
9	E	5/8	Recommend 5/8 in. as proper thickness for all future locomotives. Apply riveted ring to shell and weld flat sheet to ring using gussets on lower portion.
10	B	3/4	It is our opinion this provides proper bearing for flues and sufficient strength for high-pressure boilers.
11	E	3/4	Account higher pressures and possible use of type *A* superheater would use 3/4-in. sheet.
12	B	5/8, 3/4	All superheat locomotives have 5/8-in. sheets; however, nine new 4-6-4 type with 300-lb. pressure will have 3/4-in. sheets.
13	B	5/8	We believe this is the proper size for new equipment or for replacement of existing sheets.
14	E	5/8	This is considered the proper thickness for new equipment.
15	B	3/4	Would consider this standard for new equipment and for renewals in boilers 72 in. in diameter and larger. Have made a few replacements with riveted ring and flat sheet.
16	C	5/8	This is standard except where heavier sheets are required or lighter would be satisfactory when a saving in weight is desired.
17	D	5/8	Have experienced cracks in knuckles which vary in length from 4 in. to 50 in.
18	D	5/8	This is representative practice and was used on a recent passenger locomotive with a boiler pressure of 325 lb. per sq. in.
19	D	3/4	Have obtained very satisfactory service with this thickness, and it has been adopted as standard for all new equipment.
20	D	5/8	New passenger and freight power now under construction will have this thickness; it will also be considered for future power.
21	D	5/8	No comments.
22	C	5/8, 3/4	Either thickness may be used depending on the bracing applied and pressure carried. Both thicknesses were used on recent locomotives.
23	D	3/4	Recommend this thickness for new equipment.
24	B	5/8	This is now standard for all locomotive boilers including replacements.
25	B	5/8, 3/4	Boilers up to 225-lb. pressure have 5/8-in. sheets and those above that use 3/4-in. sheets. Have some trouble with cracked knuckles in lower portion.
26	E	1/2, 9/16, 5/8	All three sizes are used on saturated locomotives varying according to diameter of boiler. All superheat locomotives use 5/8-in. sheets. All sheets are annealed after flanging.
27	C	5/8	Based on experience would in future use this thickness. Have trouble with cracks in knuckle in bottom portion.
28	B	5/8	Consider this the proper thickness for any new locomotives that might be purchased. Sheets flanged hot and annealed.
29	D	5/8	Recommend this thickness for all new locomotives.
30	D	3/4	Present practice is 5/8-in. sheets, new locomotives will have 3/4-in. sheets. All annealed, both before and after flanging.
31	E	5/8	This practice followed on all locomotives and found to be most practical for all purposes.
32	E	5/8	Front tube sheets on new locomotives should be at least 5/8-in. thick.
33	B	3/4	Would use this thickness on new locomotives. No trouble experienced except due to corrosion.
34	E	3/4	Recommend this thickness, applied if possible without flanging or riveting.
35	A	5/8	This is standard, being used on some recently built switchers, and is also being used on passenger locomotives now under construction with boiler pressure of 275 lb. per sq. in.
36	D	3/4	The use of different thicknesses is probably the outgrowth of various experiences, some of which can no doubt be accounted for by unsatisfactory service of some kind resulting from causes quite apart from the thickness of the sheets.
37	C	5/8	This thickness is most desirable for modern locomotives.
38	C	3/4	This size is more desirable than thinner sheets, since it gives better contact with the tubes, stronger bridges, and prevents buckling. Flat gusseted sheets welded to riveted rings are used.
39	C	3/4	Considerable trouble experienced with 5/8-in. thick sheets due to cracking; 3/4-in. sheets last indefinitely. Use this on all new equipment, and for replacements; a 1 in. fillet is best.
40	A	1/2	9/16-in., 5/8-in. and 11/16-in. sheets are also used, but these give no better service than the 1/2-in. sheet. Some trouble was experienced with cracked knuckles at bottom in boilers with 2 1/4 in. flues 19 ft. long. A 2-in. radius flange and a separate short course for the front flue sheet are used.
41	E	5/8	Prefer the 5/8-in. sheet and nearly 60 per cent of their locomotives are so equipped; the remainder have 9/16-in. and 1/2-in. sheets. Have not experienced any particular difficulty with the 5/8-in. sheet.
42	B	5/8	Use this thickness regardless of boiler diameter and pressure; bridges 13/16 in. minimum. At present not experiencing any trouble.
43	B	3/4	Due to high pressure modern power carries, front tube sheets of 3/4 in. thickness are preferred unless special steel is used.
44	C	5/8	This thickness is quite satisfactory and is being used on some new 250-lb. boilers now under construction. Sheets are flanged cold and then annealed at 1,500 deg. F., this was found best after test of various methods.
45	E	5/8	Never used sheets any thicker than 5/8 in. When they had epidemic of cracked knuckles they applied patches with gussets. Last 4-8-4 type locomotives were weight restricted or they might have used 3/4-in. sheets.
46	C	3/4	No comments.
47	B	5/8	Consider this proper for large locomotives, and new locomotives ordered last year have 5/8-in. sheets. Have experienced cracked knuckles and have corrected them by increasing the radius to 2 in. Applied a 3/4-in. sheet about 11 yrs. ago and no trouble reported.
48	B	1/2, 9/16, 5/8	On saturated locomotives with boilers below 75 in. diameter, use 1/2 in. sheets, and with boilers between 75 in. and 80 in. diameter use 9/16 in. sheets. Larger boilers and all superheat locomotives have 5/8-in. sheets. Have a few exceptions.
49	D	3/4	This is standard for all classes and giving good service. Recommend adoption as standard.
50	B	5/8	This thickness of front tube sheet used for all new equipment.
51	E	3/4, 7/8	Recommend 3/4-in. sheets for new simple locomotives and 7/8-in. sheets for mallets, with inside radius of knuckle at least 3/4 in., but preferably more.
52	D	1/2, 5/8	Consider 1/2 in. sheets to be satisfactory on saturated locomotives and 5/8 in. sheets for superheat locomotives.
53	E	5/8	Will specify this thickness for new equipment. Formerly used 1/2 in. but discontinued because of cracked knuckles and some bridges.
54	E	3/4	This thickness will be used in the future on all large locomotives.
55	E	5/8	Consider this the proper thickness. Sheets are flanged cold and annealed at 1,650 deg. F. In winter sheets are preheated to 900 deg F. before flanging on machine flanger.
56	D	3/4	Adopted as standard for all front tube sheets. Trouble at a minimum. Sheets are normalized at 1,625 deg. F., which prolongs the life and relieves strains set up in flanging.

62.8 and 32.7 per cent, respectively, in the preference for the $^9/_{16}$-in. and ½-in. front tube sheets; however, the preference for ⅝-in. and ¾-in. sheets have increased 31.6 and 19 per cent, respectively.

The most prolific source of trouble continues to be cracked knuckles, which exist in all thicknesses of sheets used; however, those roads which use the ⅝-in., $^9/_{16}$-in. and ½-in. sheets report a great deal more trouble in this respect than the roads using sheets ¾ in. thick. As there are more ⅝-in. sheets used than any other, this naturally helps increase the number of trouble reports for this size sheet over the reports for sheets of the three lowest thicknesses used.

Those roads which exercise the most care in flanging, by proper annealing after forming, report less trouble from cracked knuckles. Regarding hot and cold flanging, one road reports a definite test showed that cold flanging and annealing is superior to hot flanging and annealing.

Regarding the material specifications, most all the roads use steel of A.A.R. Specification No. 115 of latest revision or their own which is very similar in physical and chemical characteristics.

A few roads are trying a flat riveted ring in the first course to which a gussets flat tube sheet is welded, thus eliminating the knuckle entirely. This method is standard on one large road and has given very satisfactory results.

Recognizing the many conditions which give rise to front-tube-sheet problems, such as the various diameters of boilers, lengths of flues, expansion and contraction, and steam pressures carried, this committee hesitates to recommend one standard thickness for all cases, but firmly believe either ⅝ in. or ¾ in. would be suitable for any condition, bearing in mind that practically 90 per cent of the replies expressed satisfaction with those thicknesses with the ⅝ in. sheet being in the majority. The radius of the flange should be not less than 1 in. nor more than 2 in., dependent on the closeness of flues to knuckle.

Safe-Ending and Applying Flues and Tubes

Committee report on modern flue-shop practices which aid in reducing maintenance costs

The committee sent out 100 questionnaires to members of this Association to obtain a complete summary of standard practices followed in the safe-ending and application of flues and tubes. The committee learned that as a rule each individual road has a standard procedure to be followed, and that a number of roads have not taken advantage of the most economical method of safe-ending flues, which the committee found to be the electric-welding method.

Until recent years, it was customary when safe-ending flues and tubes to prepare them by methods shown in Fig. 1 and, after bringing the parts to a welding heat, to complete the weld on a mandrel of a pneumatic welder by rolling or hammering. This method limits the production to a small number of flues or tubes per hour per two men.

The Committee has investigated the various items entering into the cost of safe-ending flues and tubes and has found that machinery builders today have constructed their machines with the idea of bringing the flues to each machine, and taking them away as rapidly and efficiently as possible.

As an illustration, one machine was developed for cutting off safe ends of flues. This machine will cut off a 2-in. or 2¼-in. flue in 2 sec. and will cut off a 5½-in. or 6-in. flue in about 5 sec. Therefore, the problem is the handling of the flues to and from this machine in a rapid and efficient manner; thus, enabling the machine to work at its full capacity. With this thought in mind, a complete unit was developed by Joseph T. Ryerson and Son which takes the flues off the floor and eliminates handling by manual labor almost entirely. After considerable thought, a design was worked out consisting of what are known as "flue tables," and again, with the idea of eliminating manual labor, these tables were arranged so that the flues would be propelled by gravity to the various stations where the various machines are located. At the point where the flue stops, preparatory to entering a certain machine, a device was developed which picks one flue at a time from the flue table, places it by mechanical means on a power-operated roller, rolls it into the machine, returns it to the flue table, and sends it on its way, all of these operations being performed without a man having to lift or move the flue by hand.

After the flues and tubes are removed from the boiler they are placed on flue tables or racks. Several sets of

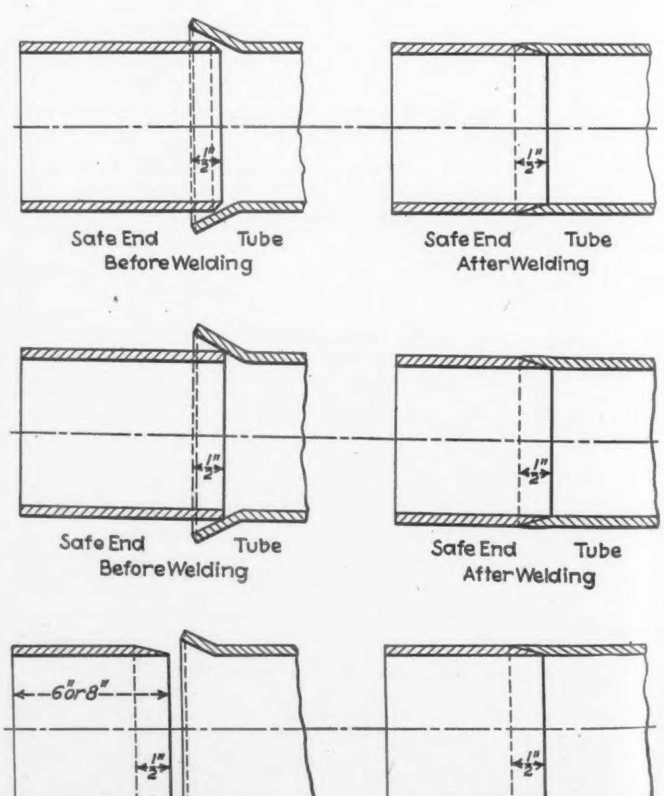
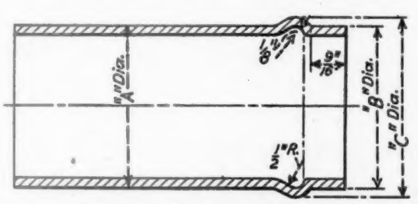


Fig. 1 Obsolete methods of safe-ending flues

flues can be loaded on these racks ready for the first operation, which is cutting off one end using a No. 0 Ryerson high-speed friction saw. After one end is cut off, the flue is lifted by an air jack and turned end-for-end; then the other end is cut off. The flues then roll to a rack leading to a sand-blast flue cleaner. At this point the flue is picked from the flue table and placed on the power-driven rolls which carry it into the Ryerson scale-cracking machine. This scale-cracker consists of three knurled crushing rollers, each of a different pitch and actuated by a cam which maintains a uniform periphery; the three rollers are adjustable, the opening of which can be made to take any size flue or tube into a sand-blasting machine which has an entrance and an exit hole for the flue to pass through. The cabinet of the sand-blast machine is rubber lined to prevent damage from the blast. This cabinet has seven adjustable nozzles with openings of ⅛ in. for air and ½ in. for sand. The flues enter the cabinet from one side and are rotated as they pass through; the sand blast removes all the scale untouched by the cracking rolls, and it also blasts out any of the pitting in the flue in which scale has collected, and exposes these pit marks to their extreme depth. The sand blast is arranged so that it will not injure a new tube nor will it remove any metal from the tube itself, as the nozzles strike a glacing blow, rather than a direct one, and the action of the sand has a tendency to peal the scale rather than to blast it. The speed of travel through the sand-blasting machine is approximately 22 ft. per min. for a 2-in. tube; 20 ft. per min. for 2¼-in. tube; 16 ft. per min. for a 3½-in. tube; and 14 ft. per min. for a 5½-in. tube.

The speed of travel through the sand-blasting machine



A	B	C	Nominal Dia. of Flues
4½"	4½"	4¾"	5⅜" and 5½"
3"	3"	3¼"	3½"

Fig. 2 End of flue or safe end after being prossered

can be regulated at the time of installation to handle the required output of flues per month, and the speeds of the flue-cracking and pulling machines can be adjusted accordingly. All of the machines in the set-up operate faster than the sand-blast cleaner; thus, when regulating the cleaning by either increasing or decreasing the speed of the sand-blast cleaners, the speed of the balance of the machines can easily be made to handle the output. After sand blasting, the flue enters the Ryerson flue-pulling machine which is the same as a scale-cracking machine, only with smooth instead of knurled rollers. The flues or tubes are then inspected and those found light in weight, pitted or corroded to any extent are scrapped.

After leaving the sand-blast cabinet, the flue rolls down to the welder. The flue is brought into the welder and onto the roller by power-driven rolls. After welding and rolling the flue is removed from the machine by the power rolls and actuating cams at this point remove the flue from the rolls and place another flue on them. These power rolls are operated with a reversing-type motor, the reversing switch of which is conveniently located near the operator's hand so that he has complete control of the movement of the flue to and from the welding machine. The Ryerson flue-rolling machine is operated with an air cylinder controlled by a foot-operated pedal conveniently located near the operator's foot.

As the flues leave the welder, they again roll by gravity down to the testing machine, then roll down again by gravity to the swedging furnace where they enter from the side. They are then heated and swedged and continue on down the flue table to a point where the second friction saw is located for cutting the flues to length.

Five men, including the supervisor, are needed to operate the flue shop just described. This number of

Nominal Flue Size	A	B
3½"	3 1/32"	3"
5⅜"	4 17/32"	4½"
5½"	4 17/32"	4½"

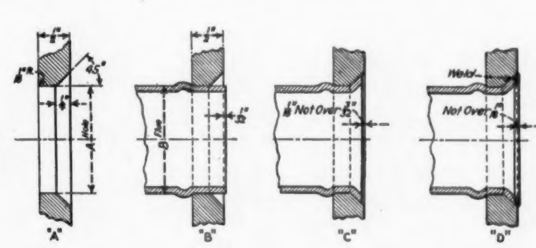


Fig. 3 Application of prossered tube without copper ferrules

men could take care of between 8,000 and 12,000 flues per month, on an 8-hr. shift. The space required will run about 100 feet square, but various layouts can be made to use irregular space in the shop if space 100 feet square is not available.

It has been found possible to take care of the flues and tubes of from 1,000 to 1,200 locomotives on one welding machine by operating it day and night. It is possible to take care of all sizes of tube and flues on one welder, but it is necessary to change the dies to suit the particular diameter of the work. An up-to-date electric flue welder is absolutely flash proof, thus insuring long life to the winding and bearings, and all moving surfaces slide on hardened and ground steel plates, thus assuring perfect alignment as well as a perfect distribution of current around the circumference of the work. The number of flues that can be welded varies from 60 to 100 per hr., but again this is based entirely on the ability of the shop to bring the flues to the machine and take them away in as rapid a manner as possible.

The troublesome ridge on the inside circumference of boiler flues and tubes, formed by rolling-in the slag from the resistance butt welds of safe-ended flues when working the hot weld over a mandrel between a set of rolls, has been eliminated successfully at the West Albany shops of the New York Central System by the simple expedient of blowing the slag from the resistance weld by a blast of air during the flash period. This method was completely described in the July, 1937, issue of the *Railway Mechanical Engineer*.

One of the new features in the application of 3½-in., 5⅜-in. and 5½-in. diameter flues is the expander machine, which does the work of the sectional expander. Putting in this prosser, shown in Fig. 2, is done hot in this machine during the swedging and welding of the safe ends. It is not rolled in—the tool in the machine gives a pushing motion as the rollers of the machine revolve. The tool revolves from a central position feeding to its full radius once in every four turns after which it again recedes to its central position so the flue can be withdrawn. This is done so that the flue will not thin out. By putting the prosser groove in the tube or safe end while hot eliminates all the formation of longitudinal cracks, and effects savings by not having to expand them by manual labor. It is difficult to expand these large flues and besides there is a stress set up which is not set up when the flue is prossered hot before application by this method.

One of the chief causes of trouble with superheater flues applied with copper ferrules, setting, belling, expanding, beading and welding around flue beads, is that

more or less trouble is experienced by welds breaking away from flues or sheets, and flues cracking longitudinally into the prosser marked.

In December, 1936, the Southern Pacific adopted its present method of applying superheater flues, eliminating the above mentioned trouble. The holes in the back flue sheet for superheater flues are countersunk at a 45 deg. angle half way through the sheet, as shown in Fig. 3*A*. In applying flues to the boiler, the prosser which is formed on the small end while the flue is hot, is set snugly against the back tube sheet as shown in Fig. 3*B*. The back end of the flue is flared out with a peen of hammer to hold them in position in the sheet, and rolled to a snug fit, care being taken to prevent excessive rolling, as a snug fit only is required. Flues are then flared out to a snug fit in countersink of the sheet as shown in Fig. 3*C*. The flues are then electric welded with one good substantial bead as shown in Fig. 3*D*, fusing well into the end of the flue to make a strong welded joint. There is no projection of the weld on the firebox side, as this weld is flush with the sheet and will run the life of the flues or the back-tube sheet without giving trouble. With this method, no ferrules are used in the back tube sheet for superheater flues.

Discussion

In the discussion of this report, a question was raised as to the results being obtained by the different roads in applying flues and tubes without the use of copper ferrules. A number of members reported that they had followed this practice and that it had so far proved entirely satisfactory.

It was also brought out during this discussion that only about 25 per cent of the roads represented at the meeting were still safe-ending flues by the mechanical method involving the use of oil or gas furnace and hammer and that the remaining 75 per cent are now using the electric welding method.

Preventing Firebox Sheets Cracking Out of Staybolt Holes

Committee report discusses improvements made in the application of staybolts to prevent cracking of sheets

This committee report is submitted in three sections with comments by Chairman C. W. Buffington, and committeemen H. E. May and R. M. Cooper.

Report by C. W. Buffington

Years ago staybolt holes were reamed and tapped by hand, and staybolts were run-in and driven up by hand; good threads, good fit, and good driving were demanded. Bolts were spread in the holes by driving in the center; then the edges were turned down. With all this care the staybolts leaked and had to be redriven repeatedly, and this caused continued leaking, which should be expected, since the bolts were driven against the sharp edge of the hole.

There have been improvements in the tools for staybolt application. We now have air tools to do this work; this has speeded up the work but has not improved the application. The U. S. form of thread is now being used instead of the V-type to facilitate application, but this reduces the holding power in regard to leakage. Only half sheets have been applied to overcome this, but they have failed to give results. Combination and taper bolts have been applied to take care of large holes, but I have never considered this the solution.

When the flanged type of staybolt hole was suggested, I thought it was the remedy and still think so, for several reasons. The trouble we have had with combustion tubes was not solved until we tried the flanged type of hole; this was the starting of the idea for the flanged type of staybolt hole.

In the flanged type of staybolt hole we have obtained the extra holding power. We have approximately ½ in. of thread in sheet, bolts can be set longer and a good head can be applied because it is driven into the radius formed by flanging the hole; the bolt is submerged against fire action and is protected by being recessed in the water space. You will note that all these points cover the things necessary to improve the application.

We made such an application on two engines in 1933 and both engines have given good results. One of these was a large freight locomotive in service on the mountain division. It was never necessary to repair these staybolts while in service. This engine has made a cycle of mileage and no staybolts were removed in the flanged-type of staybolt holes; however, 33 were removed when it came in the shop for class 3 repairs to inspect holes to see if any defects had started. No defects showed in the holes on either the water or fire side. This is the first time this has ever been done with this type of engine.

Report by H. E. May

The following report incorporates changes made in the past seven years in the maintenance of locomotive boilers on the Illinois Central. Prior to that time, conditions were as follows:

Washing of boilers was done in a very crude and haphazard manner—boilers were blown off in any way most suitable to the purposes or desires of any of our men handling work on locomotives, and were drained completely and allowed to stand empty, baking scale on interior surfaces while cooling. Washing was done with pressures ranging from 25 to 50 lb. per sq. in. with nozzles of every description. Temperature of washout water ranged from atmospheric to about 150 deg. F., and fluctuated rapidly due to lack of uniform maintenance of the supply, and the amount used. Water was heated by the water and steam blown from boilers, and when the level dropped to a certain stage, fresh water was added. Heating, therefore, was only as uniform as the space of time between each blow-down affected the supply.

The staybolt breakage during this period was very great because of strains set up by rapid change in firebox or boiler temperatures. Boilers were washed not less frequently than once each week, with one or two water changes were made on an average between each washout period.

The attention and repairs required in fireboxes were such that a locomotive was looked over for boiler work before the enginehouse foreman could figure on any locomotive at any time for a given run, due to side sheets, door sheets, flue-sheet flanges, syphons and rivet seams

cracking or leaking, and also because of the regularity with which badly leaking flues were found in fireboxes.

Large scale banks were found in barrels of boilers, between flues, between side sheet and casing sheet, between side sheets of thermic syphons, as well as around mud ring, and a heavy coating of hard scale on all sheets. This caused flues to collapse, side sheets, door sheet, flue sheet and syphons to blister and fire-crack, and fireboxes in general to require such an amount of repairs each trip that they could not be regarded as in other than a poor condition.

With a view to correcting these conditions, a complete change of methods was adopted, including the following:

Washout pressure at the pumps was increased to 200 lb. per sq. in.

Washout nozzles of a standard design were placed in use to insure the complete washing of boilers; nine nozzles in all were designed for this purpose to take care of all parts with a minimum amount of changing from one style to another, and the nozzles were placed at every point where boiler washing is done, regardless of the fact that some small terminals would only use them two or three times per month.

By maintaining 200 lb. pressure at the washout pump, we were assured of 100 lb. or more at the nozzle with water flowing through outlets at all locations in the shop. This, coupled with the heating of washout water to a temperature of not less than 120 deg. F. brought about a speedy improvement in the condition of boilers and fireboxes.

Washout periods were then extended to 15 to 30 days between washouts. This proved unsatisfactory at some points due to scale and mud in the water supply, although methods were adopted to blow boilers while in service, or while lying at terminals, to dispose of mud and scale or sludge accumulation in the mud ring.

At this time, locomotives were equipped with two blow-off cocks, located at the front of the firebox, right and left side. These cocks were ample to take care of the removal of this waste across the front mud ring and down each side sheet for about 36 in., but would not remove scale or mud which had accumulated across the door sheet and along sides to the above-mentioned location. In these locations, it was found that ten days was the limit between washouts if mud burned sheets at the back of fireboxes were to be avoided.

A locomotive was then selected at a point which was giving us the most trouble from this source and the left blow-off cock was moved to the left back corner of the mud ring. Tests were then made as to the effect this would have in eliminating deposits at this section of the mud ring, and while the condition was improved, it was found that the application of a perforated pipe across the length of the back mud ring with direct connection to blow-off cocks was necessary to provide proper suction over the greater area involved. Holes of different sizes were drilled into pipe, increasing in size uniformly with the distance from the blow-off cock to provide the same suction from the right half of the back mud ring as from the left side, near the blow-off cock. The operating lever to each blow-off cock was placed inside of cab, where locomotive crew could operate them without moving from their seats, and with proper leverage to make it possible to open or close them with one hand. Piping arrangement and a muffler were installed so that blowing could be done at any point desired, in operation on the road, or at terminals.

With the advantages these combined appliances produced, it was found that all locomotives could be operated 30 days between washouts without an accumulation of any kind that would be injurious to the sheets. This advance to a 30-day washout period, and the elimination of all improper blow-off practices, allowed us to restore the boiler water to such a concentration that with proper chemical treatment of water that contained a high percentage of hardness or other injurious content, these factors could be allowed to carry on their work in breaking down the scale so it could be blown out instead of collecting or fastening tightly on the sheets.

Variation of the water supply that gets out of control of these reducing factors is checked closely on each washout inspection, and any increase in the amount of scale found is reported on regular inspection report sent to the general locomotive and boiler inspector. These reports are then consolidated and an abstract given to the water

* * *

Oil annealing and straightening furnace

committee, which uses this information as guidance in checking more closely the changes, if any, in the supply, although they make regular checks and analyses of all water supplied, both raw and treated, each week, at the division water laboratories, which are in charge of a competent chemist, who controls the amount of change, if the need for it is indicated.

At the present time, water-testing laboratories are in use at every division point on the railroad where locomotive crews are changed, and at the end of each division (approximately 125 miles) a sample of the boiler water is taken from the bottom gage cock, whether the locomotive is relieved from service or continues on over another division. A copper bucket is used to draw samples from boilers, water being drawn off through a rubber hose connected to the bottom gage cock, and the bucket is thoroughly cleaned and rinsed with water from the boiler which is to be tested. After water is drawn, a closely fitting lid is applied to bucket and the sample is taken to the water laboratory for filtering and testing to ascertain the total dissolved content in the water in that boiler and a record is made of the locomotive number, date, name of engineer, point from which locomotive was dispatched, point to which locomotive is being forwarded, if continuing on the run and number of train locomotive is handling. Locomotives are not allowed to depart from a terminal with more than 100 grains T.D.S. per gal., and if any terminal blowing is necessary to attain this figure, the amount of such blowing is recorded by the employee doing this work, this person also indicating the T.D.S. on arrival. Record is made in a book each time a test is made covering each 24-hour period, and a copy thereof is sent to the water committee, superintendent, traveling engineer, master mechanic and general foreman, and a copy is posted in the engineman's bulletin board.

Locomotives used on through passenger trains, where crews change and departure is made before water can be tested are checked against this report to see that each engineer is blowing the boiler according to instructions, such blowing being sufficient to take care of build-up of foaming salts. These instructions cover all classes of service and specify how long to hold each blow-off cock open at intervals of a certain number of miles, this varying according to the nature of the water in any specific district.

Locomotives used in switching service are blown at intervals of a certain number of minutes, or hours, as found necessary by repeated tests made by men under the direction of members of the water committee.

All of the above changes in practice proved so beneficial to fireboxes and boilers that their condition in general has been immeasurably improved and staybolt breakage reduced 75 per cent, even though locomotives have been forced to maintain a higher efficiency than in previous years, due to increased schedules, etc.

The improvement has required the expenditure of a large sum of money, but this has been offset and a very material saving effected through the reduction in the cost of water used, coal used in firing-up cold boilers blown down for water change or washout or to make firebox repairs, as well as the increase in the life of firebox sheets and flues, and the value of having locomotives in service instead of the shop for repairs to say nothing of the satisfaction of operating boilers in good condition instead of having failures or delays en route due to leaks causing locomotives to steam poorly.

Before these practices were put into effect, the life of flues was from 18 to 30 months, with few locomotives operating a full four years without the removal of flues. All flues are now giving four years of service, with a large number of them operating a fifth year on extensions granted by the Interstate Commerce Commission. In several cases, after being operated this fifth year, we have been granted a second extension, giving us six years on flues. The life of our firebox sheets has been increased in the same proportion as the life of the flues.

Report by H. M. Cooper

Our road has made great improvements in the prevention of cracking of firebox sheets out of staybolt holes in the past 10 to 15 years, while no doubt a great deal can still be accomplished.

There are numerous causes for cracks developing in firebox sheets from the staybolt holes—among them, poor workmanship, faulty material, bad water conditions, expansion and contraction. Through any of these causes, staybolts in firebox sheets may start leaking. Bolts that are redriven and worked over to prevent the constant leaking of staybolts causes deterioration of threads in sheet and on the staybolts, and the working over of staybolts sets up strains in the sheet, coupled with expansion and contraction, leads to crystalized sheets and cracks.

A great amount of success depends on the application of staybolts; small holes should be punched in firebox sheets and patches, and then reamed to the desired size for tapping; they should not be punched over ¾ in. Care should be taken to provide good threads in the sheet and on the staybolts; also the bolts should have a snug fit in the sheet and should be cut off to a minimum size head for driving. Bolts should be upset back in the holes as far as possible.

It is a well-known fact that in previous years, before we had treated water, that extensive trouble was experienced with cracks in firebox sheets out of staybolt holes—in fact, far in excess of the trouble that is experienced at the present time. For example, on the power on our railroad, 12 to 14 years ago, it was necessary to renew side sheets on certain classes of power after from 12 to 24 months' service, and the life of the fireboxes was only from 4 to 6 years. At the present time we are getting from 12 to 15 years out of fireboxes, and 4 to 6 years on half and full side sheets; this depends to some extent, on the type of power and the service to which the locomotive is assigned.

With proper water treatment for the district in which

* * *

Welding Seams in an ashpan hopper

the locomotive is operating, we feel that it does not matter whether the staybolt holes are flanged, or whether rigid or flexible staybolts are used. With proper water treatment the desired results will be obtained from any good mechanical application.

It has been our experience that the following of the above practices in firebox applications, and close checking of water treatment for the various districts, and the keeping of boilers and firebox water spaces clean, together with the regular washing and blowing of boilers, have been our major contributing factors in the elimination of the cracking of sheets from staybolt holes.

Discussion

E. J. Brennan, general boiler foreman, Boston & Maine, said that the principal cause for cracking around staybolt holes is due to expansion and that this condition may be relieved by the use of corrugated side sheets of the proper design as evidenced by the experience with several Boston & Maine locomotive boilers which have been in service six to seven years without the development of cracks which formerly showed up inside of 24 months with straight side sheets.

J. A. Doernberger, master boiler maker, Norfolk & Western, cited several failures of corrugated side sheets and said that in his opinion it would be worth while to try counter-sinking the side sheets 1/8 in. around each staybolt hole and applying a welded bead. He said that I.C.C. prejudice against this practice on the score that it defeats the hammer or vibrating tests may be overcome by installing hollow staybolts.

K. E. Fogerty, general boiler inspector, Chicago, Burlington & Quincy, said that relief from the cracking of side sheets at staybolt holes can be secured by the application of air deflector shields just inside the firebox which prevent the cold air from cooling the lower side sheets as it enters the firebox and thus setting up expansion and contraction stresses.

Still another suggestion advanced by F. Yochem, general boiler inspector, Missouri Pacific, was that the removal of the boiler check from the side of the locomotive and locating it at the top center line of the first course proves beneficial in avoiding the introduction of relatively cool water to the bottom of the boiler including the firebox water legs and thus causing unequal expansion stresses.

Fabrication of All-Welded Locomotive Boilers

Committee report on autogenous welding and cutting—D. & H. all-welded boiler discussed

When boiler and pressure-vessel codes officially recognized autogenous welding and cutting for pressure vessels, such recognition was given only after dependable testing equipment was available and welding engineers had determined its basic principles, with the help of the various association committees. Code recognization was supplemented by standard shop tests of practices and material. Manufacturers and shops were required to keep a close check and record on their operators in order that uniformity of work was maintained. The purpose of the codes was to place responsibility on the manufacturer or operating officer, and to remove all questions of all welding engineering from the hands of the operator. Code recognition of welding and cutting has given it a definite standing and with a general improvement in engineering, autogenous process for fabrication and repairs is decidedly on the increase.

Progress in autogenous welding and cutting during the past year has been marked by many notable introductions of new applications, methods and apparatus. One of the principal factors working to increase the use of autogenous welding and cutting in recent years has been the widespread modernization of metals and equipments; this in turn with the progress in welding and cutting made it possible for welded seams and cut edges to be smooth enough for many purposes without further finishing. Furthermore, welding and cutting meet the three following factors of industrial and railroad design: Appearance, cost and durability.

Today's demand is for better products and equipment, straight lines and stream lines. Neatness, beauty and graceful lines, apparent everywhere, are facilitated by the autogenous welding and cutting process. This process is largely responsible for lighter-weight equipment. Greater strength is obtained even where very thin sections are used.

One of the most notable developments in recent years, from the railroad standpoint of fabrication, was an all-welded locomotive boiler. Because of the lack of necessary equipment in the railroad shop for doing this type of welding, as required by the Code of the American Society of Mechanical Engineers for power boilers, little interest was shown for this type of work up to about two years ago. It is only within the last few years that railroad management has shown any great interest in welded construction or any definite desire for an all-welded locomotive boiler. Because of this situation, the Bureau of Locomotive Inspection, has given no indication that welded boilers could be operated in interstate commerce. In fact, they have been opposed to the extension of welded construction for boilers and have not sanctioned its use.

From the railroad's point of view, this condition has now changed and great interest has been indicated. It is realized that worthwhile saving in weight and a smoother boiler contour can be secured by the use of the all-welded locomotive boiler. This change in sentiment was recognized by the Interstate Commerce Commission and they agreed to the construction and operation of an experimental all-welded locomotive boiler, the design having first been reviewed and approved by the General Committee on Locomotive Design of the Association of American Railroads.

The Delaware & Hudson All-Welded Boiler

This permission to build an all-welded locomotive boiler was granted to the Delaware & Hudson under the provision that it would be tested in actual operation for six weeks as a stationary unit before it was permitted to operate in road service.

The barrel portion of this boiler is conical in shape, 88 in. outside diameter at the smokebox end, and 94 in. outside diameter at the firebox end; the plate thickness is 1 1/16 in., providing a factor of safety of 5 for a working pressure of 225 lb. per sq. in. with an allowable joint efficiency of 90 per cent. The firebox inside is 132 in.

long by 114 in. wide, measured at the grate. The outside firebox wrapper sheet is ⅝ in. thick. The longitudinal and circumferential seams of the boiler shell up to the smokebox are double welded butt seams meeting all of the requirements of Section I of the A.S.M.E. Boiler Code for welded power-boiler shells and drums. The dome is 33 in. inside diameter, flanged from one piece of plate 1$\frac{1}{16}$ in. thick; the bottom flange is fitted into the shell and attached with a double-welded butt weld. The boiler shell is reinforced at this point by a flanged dome liner 1⅛ in. thick, which extends up into the dome, being attached to the dome and boiler shell by fillet welds at the edges of the liner. The throat sheet and top connection between the shell and firebox wrapper sheet is integral, having been formed from a plate 1$\frac{3}{16}$ in. thick. The backhead is $\frac{9}{16}$ in. thick of normal design, except that the flange is made sufficiently deep to permit the location of the welded joint between two rows of staybolts.

The injector check flanges, all washout plug bushings, flexible staybolt sleeves, angle attachments, and all bosses that are tapped for other attachments, to the boiler have been welded to the shell by fillet welds. The front tube sheet is welded to a circular ring which is fitted to the inside of the shell and attached by fillet welds. The ring is provided with slots at the top and bottom centers so that the tube plate can be removed and renewed without cutting out any welds except those directly attaching the tube sheet to the circular ring.

The boiler has a cast-steel firebox ring of a special cross section with flanges on the top side permitting the attachment of the ring to the firebox sheets by the bottom row of staybolts; thus, the fillet welds between the sheets and the ring are for tightness only, the ring being supported by other means. The firedoor hole is formed in the usual manner by flanging the backhead sheet inward and the firebox-door sheet outward, neatly butting these flanged edges and joining them by a single welded butt weld. All of the welds in the boiler shell, including those in the outside sheets of the back end were stress relieved in accordance with the A.S.M.E. Code requirements for power boilers.

In stress relieving this boiler shell the furnace temperature was brought up slowly to 1150 deg. F., held at that temperature for 2¼ hrs., and then allowed to cool slowly. Before the boiler shell was placed in the furnace, the firebox ring was bolted in place as a stiffening member and the flat and circular parts of the wrapper sheet were thoroughly braced to prevent distortion. The stress relieving was accomplished without any change in contour. The firebox was then applied, staybolts and tubes inserted and the boiler completed without any re-shaping being required.

The steel used in the fabrication of this boiler was to be A.S.M.E. Material Specification No. S-1, 55,000 lb. minimum tensile strength, but a special low-carbon steel was finally substituted after several tests of steel had been made, as extreme care was exercised in the selection of the material. In making tests of this latter steel, tensile-test pieces broke through the parent metal at approximately 60,000 lb. per sq. in.

The all-weld metal specimen showed a yield point of more than 50,000 lb. per sq. in., and an ultimate strength of more than 60,000 lb. per sq. in. Elongation was 30 per cent. The free-bend specimen showed an elongation in the weld metal of 30 per cent.

The bracing and staying of the backhead and front tube sheet are of the usual type for locomotive boilers. The bracing tees are riveted to the flat portions of the heads, the crow feet are riveted to the shell, and the brace rods are of the weldless type with pin connections. The tubes are applied in the normal manner and seal welded for tightness at the firebox end.

The boiler was given a hydrostatic test at twice the working pressure after the welds had been hammer tested under hydrostatic pressure at 150 per cent the working pressure.

After completion and acceptance the boiler will be installed on one of the existing Delaware & Hudson Class E-6-A locomotives, and after a stationary test period of six weeks, it will be placed in regular road service.

The performance of this boiler will be carefully followed, careful measurements will be taken from time to time and frequent inspections made to secure a complete service record.

Pending the results of these tests, the Interstate Commerce Commission will not authorize the construction or operation of any additional all-welded boilers for locomotive service and its prohibition against autogenous welding in making locomotive boiler repairs by railroads in their own shops still remains in effect as heretofore.

Welded Tender Tanks

Still another important factor in autogenous welding and cutting is the fabrication of locomotive tender tanks. These tanks are being fabricated by the autogenous welding process, preferably with the electric-arc process, in an ever increasing quantity and satisfactory methods have been gradually developed. The welding, because of the relatively thin sheets and great area of flat surface, cannot and need not be stress relieved. The tees or angles employed as stiffeners and to attach swash plates are welded with intermittent fillet welds. The welds in the outside sheets are continuous single-welded butt welds to present a smooth surface. As far as possible this welding is done in a down position.

Swash plates and bulkheads are completely fabricated ready for attachment by welding in their proper positions in the tank so that the down-position welding can be arranged for with a minimum of handling, and also to permit the major portion of the welding to be done in the open, thus leaving very little to be performed inside the tank after it becomes a partially closed structure. These fillet welds are usually either a single-pass or double-pass weld, and the use of suitable covered electrodes makes possible the production of strong welds.

Discussion

In discussion of the report the chairman of the committee appointed by the International Acetylene Association to co-operate with the Master Boiler Makers' Association submitted an illustrated talk on the effect of flame cutting upon steel boiler plate. He explained that of the items submitted in a report by his committee to this association last year, he had found that the question of the effect of flame cutting upon boiler plate, either when severing a section of plate or in removing rivets and staybolts, had proven of the greatest interest. Furthermore, he had learned that test data upon individual samples of new boiler plate as reported at the convention last year, did not impress the association as much as would have been the case if the cutting had been applied to plate actually in use in locomotive boilers.

As a result, the I. A. A. committee undertook to obtain the experimental data that seemed to be desired. Through the courtesy of A. F. Stiglmeier, a number of samples of wrapper sheet were obtained from a scrapped locomotive boiler, with the staybolts attached thereto, the fire box sheets having been cut away. The effort was made to determine, by all sorts of physical tests, the effect of flame cutting for removal of the staybolts

(Turn to next left-hand page)

as compared with the original physical properties of the boiler plate.

Much ingenuity was required to determine the types of tests that would be the most effective indicators of the resulting conditions. The committee reasoned that if the ductility of the plate material were retained after the heating effect of the flame cutting operation and no excessive change occurred in the grain structure of the steel to cause hardness or brittleness, there probably could be no reasonable question about the retention of the original physical qualities of the plate.

In order to accomplish this, it was decided to subject specimens taken from the samples of wrapper sheet to microscopic examination and tests to learn all that was possible to know about the resulting physical qualities.

Method of Making Tests

In carrying out these tests, samples were first tested without removal of the staybolts; then the staybolts were removed by the customary flame cutting operation and specimens taken out in such a manner as to test the material adjacent to the staybolt holes. The tests were carried out in such a way as to determine the ultimate tensile strength, the yield point, the elongation under tensile test, the elongation in free bending and the hardness as determined by the Rockwell "B" test; in addition plate sections were examined microscopically to give the additional check of effect upon grain structure in the heat affected zones.

The report tended to indicate that there was little difference in the physical properties of the sections taken from the wrapper sheet before and after the staybolts had been removed. Comparative figures indicated that while the specimens from which the staybolts had been removed by flame cutting showed a very slight increase in hardness adjacent to the hole after the staybolt had been removed, this difference amounted to only about ten (10) points on the Rockwell "B" scale. Coupled with this, however, was the very interesting fact that in the case of a wrapper sheet specimen in which the staybolt had been removed by drilling and no heating applied at all, the Rockwell "B" hardness test showed about five (5) points greater hardness adjacent to the threaded hole as compared with the surrounding area at a distance of an inch or more away from the hole.

Tests Show No Injurious Effect from Heating

The report showed that the tension tests and the bending of the wrapper sheet specimens from which the staybolts had been removed gave results that were not exactly comparable as those applied to the plate with the staybolt in place, because of the marked deformation of the plate adjacent to the staybolt hole. The result was, generally, a slightly increased tensile strength and a lowered ductility. In order to reduce this tendency toward deformation, another set of specimens was run through the same series in which threaded plugs were screwed into the threaded openings in the wrapper sheet specimens after the staybolts had been removed by flame cutting. These threaded plugs were made to fit quite tightly so as to restrain the hole from deforming. With the threaded plugs in place, the results obtained were much more exactly comparable with those on the wrapper sheet samples with the staybolts left in place. This tended to again establish the freedom of injurious effect from the heating due to the flame cutting operation.

In the explorations of the plate samples by microscopic studies, it was found that in no case where the staybolt head had been removed by flame cutting without injury to the threads, was there any appreciable change in the grain structure of the wrapper sheet adjoining the hole. Numerous micro-photographs were submitted to prove this. In other cases, where the flame had been deliberately caused to contact with threads in the wrapper sheet, it was shown that there was a noticeable change in the grain structure to a depth of about $\frac{1}{16}$ inch. Hardness explorations in this zone indicated, however, that the increase in hardness was only about 15 points which amounted really to a very slight change in the physical properties; it is not likely that a change as slight as this would have any material effect upon physical properties of the plate.

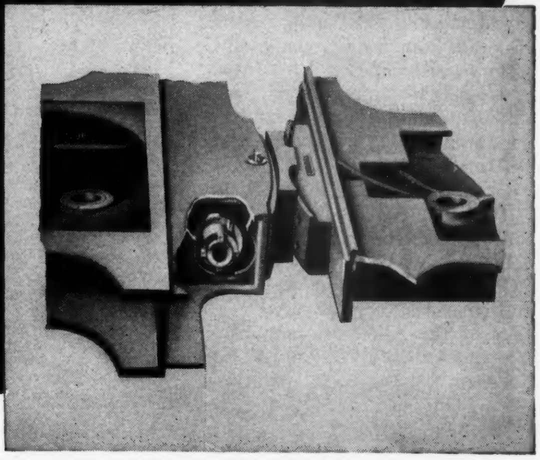
A supplement to the committee report embraced comparative tests of samples of ordinary fire box steel plate and the so-called 2 per cent nickel alloy boiler plate. These samples had been submitted to the committee by Mr. Stiglmeier in the thought that with the increasing use of nickel alloy plate in locomotive boilers it might be interesting to know the effect of flame cutting on the latter. Both physical test results and microscopic studies of the results of this investigation were submitted. These results tended to indicate that for the type of nickel alloy plate tested no appreciable difference could be expected between them as far as their strength and mechanical manipulation is concerned.

Three other prepared discussions were presented in connection with this report. These were: Arc Welding for Code Requirements, by H. S. Card, development director, National Electric Manufacturers Association, Electric Welding Division; What Development of Coated Electrodes Has Done for the Railroads, by J. A. Coakley, Jr., Lincoln Electric Sales Company, and Heat Effect in Welding, by Dr. W. G. Theisinger, welding and metallurgical engineer, Lukens Steel Company. Parts of these papers will appear in later issues.

(*Turn to next left-hand page*)

* * *

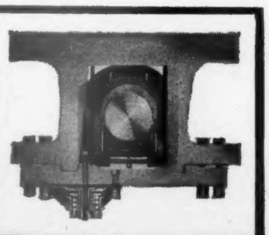
"Engineered for Easy riding"



The Type E-2 Radial Buffer makes for safer and easier locomotive riding.

Its spherical and cylindrical faces permit movement in any direction, while its predetermined frictional resistance dampens all oscillation between engine and tender and avoids all lost motion and subsequent destructive shocks to drawbar and pins.

Its twin, the Franklin Automatic Compensator and Snubber, takes the job of maintaining proper driving box adjustment and further improves smoothness of operation, extends locomotive mileage and reduces maintenance costs.



FRANKLIN AUTOMATIC COMPENSATOR AND SNUBBER

When maintenance is required, a replacement part assumes importance equal to that of the device itself and should be purchased with equal care. Use only genuine Franklin repair parts in Franklin equipment.

REG. U.S. PAT. OFF.

FRANKLIN RAILWAY SUPPLY CO., INC.

NEW YORK CHICAGO MONTREAL

NEWS

The Mechanical Exhibit at Chicago

All available space utilized for instructive and educational purposes

THE Allied Railway Supply Association made a really remarkable record in the exhibit which it provided for the mechanical conventions that met at Chicago, September 28-October 1. There were 107 exhibitors, taking up all of the available space in the Exhibit Hall and on the mezzanine floor of the Hotel Sherman.

OFFICERS ELECTED

At a meeting of the Allied Railway Supply Association on Thursday, October 29, the following officers were elected for the coming year: President, L. B. Rhodes, Vapor Car Heating Company, Washington, D. C.; first vice-president, J. W. Fogg, MacLean-Fogg Nut Company, Chicago; second vice-president, C. F. Weil, American Brake Shoe & Foundry Company, Chicago; third vice-president, F. W. Venton, Crane Company, Chicago; fourth vice-president, M. K. Tate, Lima Locomotive Works, Inc., Lima, Ohio; fifth vice-president, H. S. Mann, Standard Stoker Company, Inc., Chicago, and sixth vice-president, R. T. Peabody, Air Reduction Sales Company. J. E. Gettrust, Ashton Valve Company, Chicago, and G. R. Boyce, A. M. Castle & Co., Chicago, were re-elected secretary and treasurer, respectively.

In the story on the Allied Railway Supply exhibit in the *Railway Mechanical Engineer* for September, page 398, we overlooked including the names of the members of the Exhibit Committee. This is unfortunate, because this particular committee performed an outstanding task. Its members were J. E. Buckingham, Lincoln Electric Company, (Chairman); W. Leopold, Worthington Pump & Machinery Corporation; W. T. Lane, Franklin Railway Supply Company and J. F. Franey, Pilot Packing Company, Inc.

In addition to the exhibitors who were listed in our September number, page 401, the following additions and revisions should be made:

ADDITIONS AND REVISIONS TO LIST OF EXHIBITORS

AIR REDUCTION SALES COMPANY, New York.—Airco oxygen and acetylene; National carbide; Airco-DB welding and cutting apparatus and supplies; Wilson electric arc welding machine. Represented by C. B. Armstrong, A. W. Brown, J. T. Gillespie, C. Holt, J. W. Kenefic and R. T. Peabody. Spaces 224, 225 and 226.

APEX RAILWAY PRODUCTS COMPANY, Chicago.—Dust guard; defect card holder; Trilock safety steel; running boards; brake step. Spaces 195 and 196.

BALDWIN LOCOMOTIVE WORKS, THE, Philadelphia, Pa.—Non-exhibitor.

BUCKEYE STEEL CASTINGS COMPANY, THE, Columbus, Ohio.—Models of Buckeye six-wheel tender truck; four-wheel spring plankless, double truss truck; A.A.R. alternate standard swivel yoke assembly; A.A.R. standard E coupler; A.A.R. standard vertical plane yoke. Represented by F. J. Cooledge, M. R. Hansen, W. W. Matchneer, H. A. Moeller and George Sutherland. Spaces 209 and 210.

CARDWELL CORPORATION, THE, Peoria, Ill.—Cardwell spring truck; Cardwell journal brass remover. Represented by Thomas Cardwell. Space 247.

CASTLE & COMPANY, A. M., Chicago.—Special stools. Represented by O. F. Olson. Space 193.

CHICAGO EYE SHIELD COMPANY, Chicago.—Head and eye protection equipment. Represented by Joseph Duffy. Space 207.

CHICAGO PNEUMATIC TOOL COMPANY, Chicago.—Non-exhibitor.

COFFIN, JR., COMPANY, THE J. S., Englewood, N. J.—Coffin feedwater heater system, showing recent improvements in design and application; locomotive Superdraft. Represented by T. C. Browne, William Christiansen, W. T. Comley and Paul Willis. Space D.

GORHAM TOOL COMPANY, Detroit, Mich.—Complete set of contour tire turning tools; heavy duty insert turning tools; heavy duty insert boring tools; inserted blade cutters; helical milling cutters, shank and arbor type. Represented by H. B. Johnson and T. A. Oleck. Space 208.

HOLLUP CORPORATION, Chicago.—Welding electrodes, supplies and applications. Represented by R. C. Bender, O. L. Howland, G. O. Rohder and H. F. Ziegler. Space 148.

LOCOMOTIVE FINISHED MATERIAL COMPANY, The, Atchison, Kan.—Z-type light-weight, high-tensile alloy steel piston and cross-section of same; Universal sectional bull and packing ring made of cast iron and alloy bronze; model, one-piece cast steel locomotive cylinder; model, disk type locomotive driving wheel center. Represented by R. L. McIntosh, A. H. Moorhead, G. W. Taylor and John Welch. Spaces 211 and 212.

MURCOTT & CAMPBELL, Brooklyn, N. Y.—Files. Represented by Harry W. Leighton. Space 187.

NATIONAL TUBE COMPANY, Pittsburgh, Pa.—National boiler tubes and superheater tubes; National seamless pipe; National scale free pipe; National copper-steel pipe; National seamless mechanical tubing. Represented by J. W. Kelly, I. J. Pool, J. S. Raymond and Y. P. Yochem. Spaces 198, 199 and 200.

PILLOID COMPANY, THE, New York.—Redesigned Baker valve gear equipped with Multirol precision bearings; McGill Multirol precision bearings. Represented by L. R. Baker, Frank Fisher and R. H. Weatherly. Spaces 36, 37, 52 and 53.

RYERSON & SON, INC., JOSEPH T., Chicago.—Lewis staybolt iron; Ryerson certified alloy steel plan. Represented by J. P. Moses, A. M. Mueller and G. L. Shinkle. Space 107.

SCULLY-JONES & COMPANY, Chicago.—Boiler tools, including expanders; tube setters, flue cutters, beading tools, rivet sets, screw punches, drill sleeves, tap holders, etc. Represented by R. W. Besant and C. O. Watkins. Space 149.

SELLERS & COMPANY, INC., WILLIAM, Philadelphia, Pa.—Type "S" injector. Represented by T. H. Jessop, John D. McClintock, P. E. Raymond and Alexander Sellers, Jr. Space 197.

SPRING PACKING CORPORATION, Chicago.—Spring journal box packing; bagged Spring packing; Spring-lox for holding packing in place. Represented by William Gibbs. Space 206.

SUNBEAM ELECTRIC MANUFACTURING COMPANY, Evansville, Ind.—Locomotive headlights and turbo-generators. Represented by C. E. Kinnaw, W. E. Richard and J. Henry Schroeder. Spaces 163, 164 and 165.

THRESHER VARNISH COMPANY, THE, Dayton, Ohio.—Literature. Represented by J. C. Drummond. Space 203.

UNITED STATES STEEL CORPORATION, Pittsburgh, Pa.—See National Tube Company.

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J.—Locomotive feedwater heater; literature and equipment. Represented by S. L. Brownlee, J. F. Cosgrove, T. Cruthers, W. R. Leopold, T. C. McBride, J. W. Rafferty and T. C. Wentworth. Space 68.

YALE & TOWNE MANUFACTURING COMPANY, THE, Philadelphia Division, Philadelphia, Pa.—Yale electric industrial trucks; hand lift trucks; hoisting equipment. Represented by George C. Isbester, M. G. Peck, S. W. Gibb, J. R. Harlan and H. A. White. Spaces 142 and 143.

Baldwin Publishes Survey of Motive Power Needs

THE Baldwin Locomotive Works has recently issued a 76-page study entitled "The Motive Power Situation of American Railroads," which, on the basis of statistics compiled largely by the Federal Co-ordinator of Transportation and the Interstate Commerce Commission, establishes the contention that the purchase of new motive power, as opposed to rehabilitation of existing rolling stock, is essential to the continued health of the American carriers. Upon a groundwork of history of rail traffic since 1900 and a presentation of

(*Turn to next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the September Issue

LOCOMOTIVE ORDERS

Company	No. of locos.	Type of loco.	Builder
Lehigh Valley	2*	600-hp. Diesel-elec.	Electro-Motive
	2†	900-hp. Diesel-elec.	Electro-Motive
	2‡	900-hp. Diesel-elec.	Electro-Motive
B. & O.	1	16-cylinder steam	Company shops
M., St. P. & S. S. M.	1	Snow plow	Russell Snow Plow Co.
Pennsylvania	1	600-hp. Diesel-elec.	Electro-Motive

LOCOMOTIVE INQUIRIES

Westinghouse Air Brake	1	0-4-0 switching	....

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
General Chemical Co.	90	Tank	American Trans. Corp.
M., St. P. & S. S. M.	100	40-ft. 50-ton steel box	Pullman-Standard
U. S. Navy Dept.	2	Flat	Haffner-Thrall Car Co.

PASSENGER-CAR INQUIRIES

Road	No. of cars	Type of car	Builder
A. T. & S. F.	17	Coach	....
	20	Baggage	....
Pennsylvania	6	Coach	....
	4	Passenger-baggage	....
	4	Baggage-mail	....
	5	Dining	....

* Are now in service.
† Will be placed in service about Jan. 1, 1938.
‡ Will be placed in service about May 1, 1938.

present-day locomotive inventories, the study concludes that about 94.4 per cent of all motive power measured numerically and 91.2 per cent by tractive power is "more or less obsolete."

Stepping to its second chief topic, the cost of locomotive maintenance and operation, the study points to statistics and conclusions published in reports of the Federal Co-ordinator of Transportation defining the economic life of a locomotive and purporting to prove that increased maintenance costs do not warrant the continued use of motive power beyond these defined limits. Further statistics point to the advantages of the speed, economy, and power of the modern locomotive, with emphasis on the necessity of an adequate locomotive replacement program and the importance of writing adequate depreciation charges in capital accounts.

Further quotations support the contention that, although due credit must be given to the virtue of Diesel power, the steam locomotive must "continue to be the mainstay of railroad operation for the indefinite future." Complete tables and graphs supporting the thesis follow.

B. & O. 16-Cylinder Steam Locomotive

Designs have recently been completed by the B. & O. for a 4-8-4 type steam locomotive which will be powered by Besler steam motors. Each of the four driving axles will be driven by a four-cylinder steam motor geared to the axle. It is estimated that this locomotive will develop 5,000 hp. and be capable of speeds of 100 m.p.h. on straight level track with a train of 14 standard Pullman cars. The locomotive will have a tender mounted on two six-wheel trucks with a coal capacity of 23 tons and a water capacity of 22,000 gallons.

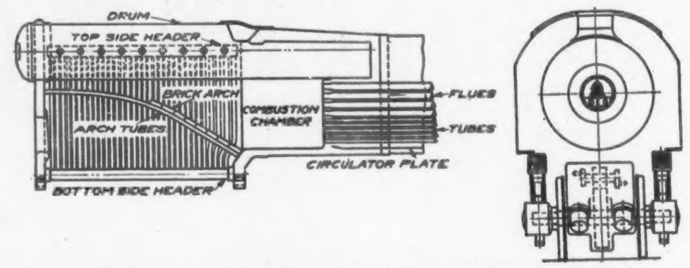
The arrangement of the four Besler steam motors gives a total of 16 cylinders with 32 impulses to each revolution of the steam motors. With this design no counter balancing will be required, and, inasmuch as there are no main and side rods or crankpins, hammer blows on the track will be eliminated. The absence of main and side rods and other motion work will also make it possible for the driving wheels, with their independently mounted steam motors, to negotiate sharper curves than locomotives of conventional design.

Gears and all other moving parts of the steam motor will operate continuously in a bath of oil forced by a pump to wearing parts. The cutoff position of the valve gear together with reversing mechanism will be automatically regulated from the cab by means of electro-pneumatic control.

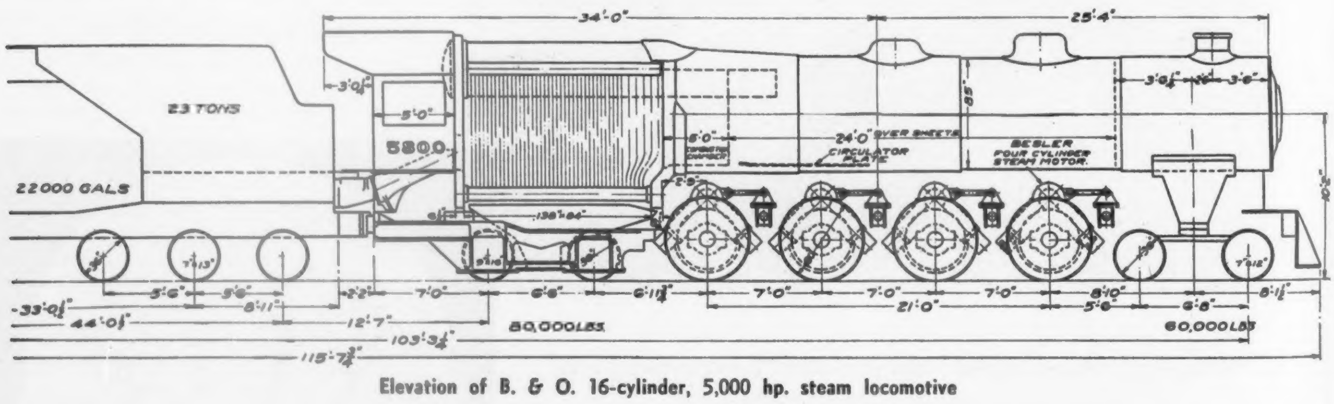
The total weight of the locomotive will be about 400,000 lb., 260,000 lb. of which will be on drivers. The total weight of the tender will be 350,000 lb. The tractive force at starting will be 72,500 lb., giving a factor of adhesive of 3.6 which is more than ample with the uniform torque. The Besler steam motors have a bore and stroke of 9½ in. by 7 in., and the gear ratio between the steam motors and the axle is 19 to 55. The total driving wheelbase is 21 ft., and the total engine wheelbase is 46 ft. 7¾ in. The total engine and tender wheelbase is 103 ft. 3¼ in., and the length overall is 115 ft. 7¾ in.

The locomotive will be equipped with an Emerson water-tube firebox boiler having 775 sq. ft. of heating surface in the firebox and a total heating surface of

(*Turn to second left-hand page*)



Longitudinal section of firebox and combustion chamber and (at right) the cross section showing the arrangement of steam motors



Elevation of B. & O. 16-cylinder, 5,000 hp. steam locomotive

Artist's conception of the proposed B. & O. locomotive powered by four four-cylinder steam motors

5,800 sq. ft. It will have a superheating surface of 1,530 sq. ft. and will be equipped with a feed-water heater. The firebox will be 138 in. by 84 in. and have a grate area of 80.5 sq. ft. The Besler steam motors operate on a guaranteed rating of 14 lb. per hp., and when the locomotive is developing 5,000 hp. the cylinders will require 70,000 lb. of water per hr., while the boiler will evaporate 80,500 lb. The working pressure is 350 lb. per sq. in.

The new locomotive will be extremely flexible in design and will have outside frames and spring rigging with oil-lubricated outside journal boxes. Each pair of driving wheels with its attached steam motor can be quickly removed on a drop pit for necessary repairs.

The locomotive will be streamlined on a pattern developed for the B. & O. by Otto Kuhler, consulting engineer of design. The design has been used in an adapted form for the streamlining of the B. & O.'s Diesel-electric locomotives and its New York train-connection motor coaches. A President-type B. & O. steam locomotive, streamlined along the lines for the proposed new locomotive, will soon be placed in service.

H. S. Air Brake Shown at N. Y. Science Museum

A complete train brake system of the electro-pneumatic high-speed type developed for use on fast streamliners has been installed in the New York Museum of Science and Industry, Rockefeller Center, New York, as a further development in the "do it yourself" exhibit.

Visitors who have yearned to run a real train may experience something of a thrill by pushing a lever controlling the exhibit mechanism. The latter controls a miniature train, modelled after the type which uses this type of brake, which, when the controls are set, moves along a scale track. Below this, a working model of the air brake system in nearly full size operates in sequence illustrated by arrows.

A complete diagram of the mechanism of the locomotive unit in a typical Diesel-electric streamliner has also been located in the exhibit.

Big Railroad Exhibit at New York World's Fair

Formal contract for the greatest amount of exhibit space and the largest single display at the New York World's Fair 1939 was signed on September 15 by the Eastern Presidents' Conference, composed of the heads of 34 railroads, and Grover Whalen, president of the Fair. The contract calls for the occupancy of 676,888 sq. ft. of space in the Transportation Section, upon which the combined roads will erect a building containing 110,000 sq. ft. of exhibit space. The rental price is $97,438 and the fund set up for the construction of the building and assembly of exhibits amounts to $1,500,000. Within the building, the main entrance of which will carry out the design of a roundhouse, and upon the surrounding terrain, the railroads hope to tell the whole story of railroading in the United States, from the early days of wood-burning locomotives to the streamline, motor-driven trains of today, and also to portray graphically what the traveling public may expect in safety, comfort and speed in the years to come. Provision will be included for track shows and stage spectacles for an audience of 4,000.

C. M. St. P. & P.—Correction

In the table of equipment orders and inquiries on page 425 of the September issue an order for 1,000 gondola cars of 70 tons' capacity, placed by the C. M. St. P. & P. in its own shops, was included. This is incorrect in that these cars were included in a previous order for 2,022 cars included in the *Railway Mechanical Engineer* table of equipment orders and inquiries for May, 1936, page 242.

Stokers for Big Locomotives

Expressing the belief that the use of large hand-fired coal-burning steam locomotives in fast and heavy service causes unnecessary peril to the life and limb of travelers and employees on the railroads, Special Examiner Homer C. King of the Interstate Commerce Commission, in a proposed report to the commission, has recommended that it order the railroads of the country to equip approximately 3,500 of their remaining locomotives, used in through service, with automatic stokers. The case arose in 1930 upon the complaint of the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen and was directed against all the railroads of the country, which are subject to the Interstate Commerce Act. Hearings were held in 1931, and were then suspended until 1936, when they were resumed and completed in the early part of 1937, in Washington.

The report states that while the complaint as originally filed included all coal-burning steam locomotives not mechanically fired, the complainants by a statement of record which was entered at almost the end of the hearings, withdrew their request for the installation of stokers on passenger locomotives weighing less than 125,000 lb. on driving wheels, and consuming less than an average of 1,800 lb. of coal per hour; and on freight and yard locomotives weighing less than 150,000 lb. on driving wheels, and consuming the same amount of coal as the passenger locomotives.

In tabulating the returns from a questionnaire which was sent to all the railroads and which involved 47,393 locomotives, the examiner points out that of this number, 8,154 were assigned to passenger service, 6,831 of them using coal as fuel. Of that number, 1,347 were equipped with stokers, the vast majority being used in through service. The average weight on the driving wheels of these locomotives equipped with stokers was 209,000 lb. The questionnaire also showed that all passenger locomotives weighing 250,000 lb. or more were equipped with stokers; of 1,018 weighing between 200,000 lb. and 250,000 lb., 532, or slightly more than 50 per cent, were so equipped; of 1,570 weighing between 170,000 and 200,000 lb., 515, or approximately 33 per cent, were so equipped; and of the 4,064 which weighed less than 170,000 lb., only 125 had stokers.

The questionnaire also discloses the fact that out of the 26,000 freight locomotives, about 21,000 used coal as fuel, and 10,160 were equipped with stokers. The average weight of the stoker equipped freight locomotive was found to be about 280,000 lb.

After examining the various types and weights of locomotives used in both freight and passenger service, the examiner comes to the conclusion that all passenger locomotives weighing more than 170,000 lb. and all freight locomotives weighing more than 185,000 lb. should be equipped with automatic stokers. He goes on to say that the weight limits "are, if anything, too high," but he feels that they are "sufficiently high to avoid the possibility of including any locomotives which may be hand fired and operated without unnecessary peril to life or limb."

The final question to be discussed by the proposed report is that of the cost of the application of stokers. The railroads had alleged in their answer to the complaint that the cost of applying stokers to all locomotives would be approximately $115,000,000. The examiner says the record shows that the cost of installing a stoker is around $3,000. The returns from the commission's questionnaire shows that as of February 28 there were not more than 3,500 locomotives on which the application of stokers would be necessary in order to comply with the recommendations of the examiner. He estimates that the total cost of the installation should not be more than $11,000,000. Since the cost of maintenance of the stoker is approximately one cent per mile, the examiner concludes that the application of stokers to the remaining 3,500 locomotives would be an economical move for the carriers in view of the fact that the railroads admit that the stoker provides for more efficient operation of the engine.

Examiner King would have the commission find that in order to prevent unnecessary peril to life or limb, and to promote the safety of employees and travelers upon railroads, no coal-burning steam locomotives built on or after April 1, 1938, which weigh 170,000 lb. or more on driving wheels, shall be used in through passenger service; and that no coal-burning steam locomotives built on or after that date, which weigh 185,000 pounds or more on driving wheels, shall be used in through freight, helper, or transfer service, as defined in this report, unless equipped with automatic stokers, or other mechanical means of supplying fuel to the fire; (2) that on and after April 1, 1938, no coal-burning steam locomotives of the respective weights on driving wheels above referred to, and used in the services above set forth, built prior to that date shall be used in said services after receiving class 3 repairs or heavier, subsequent to said date unless equipped with automatic stokers or other mechanical means of supplying fuel to the fire; (3) that on and after April 1, 1943, no locomotives of the respective weights on driving wheels above referred to shall be used in the services above set forth, unless equipped with mechanical means of supplying fuel to the fire.

(*Turn to next left-hand page*)

Supply Trade Notes

D. L. Townsend, formerly with the engineering department of The Symington-Gould Corporation at Rochester, N. Y., has been assigned to the company's Chicago office.

Steel & Tubes, Inc., a subsidiary of the Republic Steel Corporation, Cleveland, Ohio, has opened a branch office in Baltimore, Md., with H. H. Smith in charge.

Ralph C. Harden has been appointed general manager of the eastern division of the Gustin-Bacon Manufacturing Company, Kansas City, Mo. Mr. Harden, who will have his headquarters at New York,

Ralph C. Harden

has had an extensive sales and executive experience. For a number of years he was associated with the Johns-Manville Sales Corporation as salesman, insulation and packing sales manager, division manager and regional vice-president, with headquarters at Chicago. For the past three years, he has served as a general department sales manager with the United States Rubber Products, Inc., New York.

The Pittsburgh Tool-knife & Manufacturing Co., Pittsburgh, Pa., has moved into its own newly equipped plant at 75-81 Sycamore street, Etna P. O., Pittsburgh, Pa. A new office building was erected, adjoining the main plant.

The partnership Thomas Prosser & Son, heretofore consisting of Richard Prosser and Roger D. Prosser, doing business at 15 Gold street, New York, has been dissolved by the death of Richard Prosser on July 12. Roger D. Prosser will continue to conduct the business of that partnership under the name of Thomas Prosser & Son at the same address.

Howard V. Harding has become associated with Lukenweld, Inc., Division of Lukens Steel Company, Coatesville, Pa., as district sales manager in the metropolitan territory with headquarters at 120 Liberty street, New York. John McC. Latimer has been appointed exclusive representative of Lukenweld in Western Pennsylvania territory, with headquarters in the Koppers building, Pittsburgh, Pa.

R. B. Pogue, who has been appointed chief engineer of the American Brake Shoe & Foundry Company, New York, as noted in the September issue, is a graduate of the University of Kentucky. In 1915 he received his master of science degree in railway mechanical engineering and electrical engineering from the University of Illinois. After a short special apprenticeship on the Chicago, Rock Island & Pacific, he entered the inspection department of the American Brake Shoe & Foundry Company in 1916. He was on leave during 1917 and 1918 to serve in the United States Army Signal Corps and Bureau of Aircraft Production, at Buffalo, N. Y. Returning to the American Brake Shoe & Foundry Company in 1918, he was engaged in inspection and operation work, later serving as superintendent of its Burnside plant. Mr. Pogue was transferred to the experimental department in 1927, and was appointed assistant chief engineer in 1929.

Rosser L. Wilson, the newly appointed assistant chief engineer of the American Brake Shoe & Foundry Company, was graduated from Purdue University in 1925, with a mechanical engineering degree. He assisted from 1925 to 1931 in conducting the A.R.A. power brake investigation, two years of this time being spent with the test train on the Pacific Coast. Mr. Wilson joined the American Brake Shoe & Foundry Company in 1935.

Wallace B. Sutherland, assistant to the chief engineer, has been in the service of the American Brake Shoe & Foundry Company since 1913. He began as junior draftsman and in 1920 became chief draftsman. Since his association with the company his duties have been connected with braking problems.

Obituary

Miss A. M. Kelly, secretary and assistant treasurer of the G. M. Basford Company, passed away at her home, 1045 Park Avenue, New York City, on Wednesday, October 6. Miss Kelly was secretary and assistant treasurer of the Basford Company since its founding in 1916, and was active in its affairs up to the time of her death. Prior to her connection with that company she was with the American Locomotive Company and Joseph T. Ryerson & Son. In addition to being secretary of the G. M. Basford Company, she was also secretary and treasurer of the Locomotive Feed-Water Heater Company.

Personal Mention

General

F. S. Robbins has been appointed superintendent motive power of the Atlantic Coast Line, with headquarters at Wilmington, N. C.

R. B. Hunt, master mechanic of the Florida East Coast, has been appointed acting superintendent of motive power and machinery, with headquarters as before at St. Augustine, Fla., succeeding F. S. Robbins.

A. C. Adams, superintendent of motive power, who has retired after more than 50 years of railroad service, entered railway service in 1884 and became a machinist apprentice on the Missouri Pacific in 1886. From 1887 to 1906 he became, successively, machinist, enginehouse foreman, division foreman and master mechanic on the Chicago, Rock Island & Pacific. He then served as master mechanic, in turn, for the Chicago, Burlington & Quincy, the Delaware, Lackawanna & Western, and the New York, New Haven & Hartford. From 1911 to 1914 he was superintendent of motive power of the Spokane, Portland & Seattle and during 1915 was engaged in the supply business. Mr. Adams became master mechanic of the Seaboard Air Line in 1916-1917 and superintendent of shops of the New Haven at Readville, Mass., in 1917. From 1918 to January 1, 1921, he was a member of the Railway Board of Adjustment No. 2, U. S. Railroad Administration, at Washington, D. C., and on January 1, 1921, became superintendent of motive power of the Norfolk Southern.

James H. Wilson, who has been appointed assistant chief mechanical officer of the Norfolk Southern at Norfolk, Va., succeeding A. C. Adams, entered railroad service in 1902 as a machinist apprentice on the Seaboard Air Line. He subsequently served in the electrical department

(*Continued on next left-hand page*)

James H. Wilson

of the Atlantic Coast Line, and in October, 1917, became chief electrician of the Norfolk Southern. He was promoted to the position of chief mechanical inspector and assistant superintendent of motive power on March 16, 1934, and on September 1 of this year became assistant chief mechanical officer.

LESTER H. KUECK, assistant chief mechanical engineer of the Missouri Pacific, has been appointed chief mechanical engineer. He has been in the employ of this

Lester H. Kueck

company for 20 years. Mr. Kueck was born on July 20, 1895, at Sedalia, Mo., and entered the service of the Missouri Pacific on April 1, 1917, as general draftsman. From September 21, 1920, to February 15, 1924, he served as a general draftsman on the Texas & Pacific (controlled by the Missouri Pacific) at Marshall, Tex. In 1924 he returned to the Missouri Pacific as general draftsman at St. Louis, holding this position until February 2, 1926, when he was advanced to chief draftsman. On September 1, 1935, Mr. Kueck was promoted to assistant chief mechanical engineer, and held this position up to the time of his recent appointment.

Master Mechanics and Road Foreman

J. F. HUNT has been appointed assistant master mechanic of the Pittsburgh division of the Pennsylvania.

ALFRED J. GRAHAM, assistant road foreman of engines of the Pocahontas division of the Norfolk & Western, has been appointed road foreman of engines of the Pocahontas division.

FRED R. LITZ, electrical engineman on the Pocahontas division of the Norfolk & Western, has been appointed assistant road foreman of engines of the Pocahontas division, succeeding Alfred J. Graham.

Shop and Enginehouse

M. H. WESTBROOK, superintendent of shops of the Grand Trunk Western, at Battle Creek, Mich., retired on September 1 after 46 years of service on that road.

C. E. MILLS has been appointed general enginehouse foreman of the Boston & Albany, with headquarters at Allston, Mass., succeeding A. L. Wright.

A. L. WRIGHT, general enginehouse foreman of the Boston & Albany at Allston, Mass., has been appointed shop superintendent, with headquarters at West Springfield, Mass., succeeding J. F. Murphy, deceased.

WAYLAND F. SMITH, air brake foreman of the Atchison, Topeka & Santa Fe at San Bernardino, Calif., retired on September 1. Mr. Smith entered the service of the Santa Fe in September, 1884, at the age of 14.

Purchasing and Stores

E. L. FRIES, special representative of the executive vice-president of the Union Pacific, with headquarters at Omaha, Neb., has been appointed general purchasing agent, with headquarters at Omaha.

CHARLES A. KEEBLE has been appointed purchasing agent of the Union Pacific, with headquarters at Los Angeles, Cal. Mr. Keeble was born on March 2, 1899, at Los Angeles. After attending Occidental college, he entered railway service in Janu-

Charles A. Keeble

ary, 1918, with the Southern Pacific. He entered the service of the Union Pacific in the stores department in 1919, and on September 12, 1922, was assigned to the chief engineer's office. On January 1, 1923, he became connected with the purchasing department, where he advanced through various positions until September 1 of this year, when he became purchasing agent.

Obituary

FRED JACKSON, master mechanic of the Lehigh & Hudson River Railway, died on September 16 at his home at Warwick, N. Y.

GEORGE WHITELEY, superintendent of the motive power and car department of the Canadian Pacific, with headquarters at Toronto, Ont., died on September 29.

CHARLES S. BRANCH, master mechanic of the Alton, with headquarters at Bloomington, Ill., died at his home on September 5, following an emergency operation for appendicitis performed a week previously.

C. O. DAVENPORT, master mechanic of the Chicago, Burlington & Quincy, with headquarters at Casper, Wyo., died suddenly of a heart attack on September 20 while standing on the station platform at Casper.

JOHN F. MURPHY, superintendent of shops of the Boston & Albany at West Springfield, Mass., died on August 29. Mr. Murphy was born in 1880 at Springfield,

J. F. Murphy

Mass. He attended the public and evening trade schools, and on May 1, 1898, became a helper in the enginehouse of the Boston & Albany. In 1902 he was transferred to the shops and in 1908 was the first apprentice to serve his time on the B. & A. He then became a machinist leader and in 1912 was promoted to the position of machine shop foreman. In 1928 he was appointed assistant general foreman of the locomotive shops, and from July, 1935, until his appointment as superintendent of shops early in 1936 had been acting superintendent of shops. Mr. Murphy was one of the organizers of the Boston & Albany Supervisors' Clubs. He was always an active supporter of apprentice training.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

ELECTRIC WATER COOLERS.—Electric water coolers for railway application are illustrated and described in the four-page bulletin issued by General Electric, Schenectady, N. Y.

DART UNIONS.—The catalog published by the E. M. Dart Manufacturing Company, Providence, R. I., contains data on Dart pipe unions and fittings, with color illustrations showing the full-bearing, ball-joint construction of the unions.

HOISTING EQUIPMENT.—Every type and modification of Yale hand chain hoists are fully described and illustrated in the 40-page catalog of the Yale & Towne Manufacturing Company, Philadelphia, Pa. Another booklet of 12 pages is devoted to chain hoists, a spare parts list and oiling instructions.